RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL, AND AGRICULTURAL

DISCOVERIES:

BEING

An Abridgement

805

OF THE

PERIODICAL AND OTHER PUBLICATIONS,

ENGLISH AND FOREIGN,

RELATIVE TO

Arts, Chemistry, Manufactures, Agriculture, and Natural Philosophy;

ACCOMPANIED OCCASIONALLY, WITH

REMARKS ON THE MERITS OR DEFECTS OF THE RESPECTIVE PAPERS;

AND, IN SOME CASES, SHEWING TO WHAT OTHER USEFUL PURPOSES INVENTIONS MAY BE DIRECTED, AND DISCOVERIES EXTENDED, BEYOND THE ORIGINAL VIEWS OF THEIR AUTHORS.

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PREFACE.

IT is with considerable satisfaction that we present our third Volume to the public. Experience having rendered us more familiar with the duties of our office, we have been better enabled to complete the plan we originally proposed, and we trust that an examination of the following pages will shew that our labours will bear an advantageous comparison with our former attempts.

The assistance with which we have been honoured, from persons eminent for their knowledge and talents, has been too flattering to permit us to relax in our future endeavours to merit the farther sanction and patronage of the public.

The agricultural part of our Retrospect, has been enriched with the abridgements of the papers published by the Horticultural Society; which we flatter ourselves will be found not the least valuable part of our micellany. These papers, from their general usefulness to every class of society, claimed our peculiar attention.

The increased difficulty of communication with the Con-

tinent, has rendered the insertion of foreign papers, very irregular, and we are apprehensive will for some time to come deprive us of that interesting source of information.

This, however, we are conscious will in some degree be compensated by the importance of those communications, which will naturally be produced at home from the very brilliant discoveries of Mr. Davy, which constitute an æra in science, and from the no less important experiments of Mr. Braconnot, which seem likely to produce a great alteration in the present theory of chemistry.

The accounts given of Patents in this work are, we believe, highly satisfactory and interesting to those who wish for a general knowledge of such inventions and discoveries as are encouraged by the advantageous privileges which a patent confers.

The references made to the sources whence each article is taken, enables those who wish for more minute information on any subject noticed by us, readily to consult the original.

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RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL, CHEMICAL AND AGRICULTURAL DISCOVERIES.

No. VIII.] *January, February, March.* [1807.

CHEMISTRY AND MINERALOGY.

On Native Minium, by James Smithson, *Esq* F.R.S. *Phil. Trans. Part* II. 1806.

It is disseminated in small quantity, in compact carbonate of zinc. It is pulverulent, but in some places exhibits a flaky and crystalline texture. Its colour is vivid red, with a cast of yellow. Gently heated by the blow-pipe it becomes darker, but on cooling returns to its original red: by a stronger heat it melts into litharge, and when melted on charcoal it is reduced.

In nitric acid, it becomes brown; and by the addition of sugar forms a colourless solution. Added to muriatic acid, it enables the acid to dissolve gold; the vapor also of the acid is thus enabled to destroy the colour of paper tinged with litinus or even with indigo.

It seems to arise from the decay of galena, as a crystal has been found, the internal part of which is galena, while the external part is native minium. Mr. S. also supposes that galena itself is a metallisation of white carbonate of lead by hepatic gas.

Observations.—Mr. Smithson does not say where this ore was found, but as the letter to Sir Joseph Banks, in which he gives the above description, is dated from Cassell, in Hesse, it is probably a production of that country.

The mineralogical description of this fossil being so meagre, it is not possible to say whether it is only a variety of the *bleierde* of Werner, as seems most likely to be the case.

Description of the Mineral Basin, in South Wales.—By Mr. Edward Martin.—*Phil. Trans. Part.* II. 1806.

All the strata of coal and iron stone, in South Wales, are deposited in a limestone basin of an irregular oval form, 100 miles in length; and whose breadth is, where broadest, (namely, in the counties of Monmouth, Glamorgan, Carmarthen, and Brecon) from 18 to 20 miles, and where narrowest, (namely, in Pembrokeshire) about three to five miles.

The deepest part of the basin is between Neath in Glamorganshire, and Llanelly in Carmarthenshire. The uppermost stratum of coal is of course found here. It does not extend a mile in a north and south direction, nor many miles from east to west. The utmost depth of this stratum does not exceed 50 or 60 fathom.

The succeeding strata of coals lie deeper and expand in length and breadth. They are accompanied with parallel strata of iron ore in irregular balls or lumps. The lowest strata at the centre range is from 600 to 700 fathoms deep.

The strata in the narrow slip from Pembrey Hill through Carmarthen Bay and Pembrokeshire to Saint Bride's Bay are only a continuation of those in the counties of Glamorgan and Carmarthen which lie the deepest, for in this slip none of the strata of coal or iron ore lie above 80 or 100 fathoms deep: the more superficial strata not having reached this narrow slip by reason of its not being of sufficient depth and width to receive them.

The coals on the east of the basin, viz. from Pontypool to Clydach, and from thence on the north-east edge to Kurwain iron furnaces, are of a coking quality. From thence on the north-west of the great basin, and in the narrow slip, the coals alter to stone coal. Those on the south edge of the great basin, viz. from Pontypool to Pembrey Hill are of a bituminous or binding quality.

There are 12 strata of coal in this basin from three to nine feet thick, and 11 others from 18 inches to 3 feet, making in all 95 feet; besides a number of thinner veins not reckoned. So that the produce of this coal-field is upon the average 1000 square miles, producing in the common way of working 64,000,000 tons per square mile.

The faults, or irregularities, take grand ranges, through the interior of the basin, generally in a north and south direction, and often throw the whole of the strata for 40 or 100 fathoms up or down. The greatest faults frequently lie under even surfaces. A very remarkable fault is observable at Cribbath where the strata of limestone stand erect. Another of considerable magnitude oc-

curs between Ystradvellte and Penderryn where all the strata on the north side of the basin are moved many hundred yards to the south, as at Dinas.

The limestone which forms the substratum of this mineral deposition appears to the surface all along the boundary of the basin, and it certainly has an underground connection from point to point.

Observations.—We may regard this paper as the first fruits of the geological history of Great Britain; and we sincerely hope it will be followed up by a description of the other "fields" and "countries" of which our island consists, as from this investigation the most useful results must ensue. Among the list of premiums to be given by the Society of Arts, &c. we should be glad to see a general one for any description similar to the present, accompanied with a map of the same kind, and a section of the field where deepest.

On Lichen Islandicus, as Food. By Prof. Proust. *Journ. de Phys. Août,* 1806.

A notice from Prof. Proust had already been inserted in this Journal relative to the use of lichen islandicus as food, of which we gave an extract in vol. ii. p. 361. The present paper gives a more detailed account of his experiments upon this plant, but we shall omit such particulars as we have already mentioned.

The lichen is already used in many countries as a dietetic plant. The Icelanders keep it in sacks till wanted. They then wash it and reduce it to flour, two tons of which are esteemed equal to one of wheaten flour. It is soaked in water for a whole day to extract a bitter principle, and then boiled with whey so as to form a gelly, which is eaten either hot or cold, with milk, or more whey.

The Laplanders boil the lichen in one or two waters, which they throw away, they then wash it in cold water, and after bruising it, they boil it in milk, and season it with salt.

The Swedish botanists, when in Lapland, in 1788, soaked it over-night in hot water, and boiled it in the morning with milk.

In Carniolia they drive their sick and emaciated horses or cattle to the places where the lichen grows in abundance, and in less than a month the horses and cattle not only recover their flesh, but even grow fat.

The pastoral inhabitants of the southern Asiatic Nessia feed on this lichen when other food is scarce.

Dried lichen recovers, by a very short immersion in cold water, its colour and original weight. When kept under water for three or four days it deposits a light fawn colour sediment, but does not lose its bitterness. But pulverised lichen soaked in cold water for three hours only deposits a fawn colour bitter principle resembling that of succory. This bitter principle has no aromatic odour, nor is it very disagreeable. In the course of 12 hours the lichen loses only 3 per cent. of its weight. If warm water is employed the loss amounts to 5 or 6 per cent. as some of the nourishing matter is taken up.

The bitter principle of the lichen is of the nature of extractive matter, it yields a brown colour with iron, and is employed in dyeing in Iceland; but our dyes are much superior. The nutritive matter of the lichen differs widely from sugar, gum, or farinaceous matter, and is not taken up, in any considerable quantity, by water, during the short time required for dressing the plant, as a quarter of an hour's boiling is sufficient for this purpose. Besides the great increase of weight, as mentioned in his former paper, the boiled lichen has this remarkable quality, that after being pressed it instantly returns to its former volume, like a sponge. This renders the lichen extremely agreeable between the teeth, and gives it the appearance of a fresh sallad, an appearance which is peculiary desirable at sea. The use of lichen as ship stores would, therefore, be highly useful; it is not subject to be injured by insects, and if dressed on shore and then dried would only require to be moistened with cold water for some time to be eatable; even the sea-water might be used for this purpose.

If the lichen has been boiled only for a few minutes in water, some of the bitter extract will remain in it, but this will not render it very disagreeable. The dressed lichen is of an unequal fawn yellow colour, which is disagreeable at first, as is also its smell, which slightly resembles that of sea weeds. It has great analogy to the fucus, called *luche*, at Lima, that is so much eaten along the coasts of Peru and of Chili.

One lb. of dried lichen yields 3 lbs. when dressed; on drying these 3 lbs. are reduced to $\frac{2}{3}$ of a lb. hence the lichen loses $\frac{1}{3}$ of a lb. by boiling in water, and takes up $2\frac{1}{3}$ lb. of that liquid. This does not render it less nutritive, as it is not the solid parts only of our aliments that is altered by digestion, the water itself is, without doubt, decomposed, and furnishes two elements to the new products.

From these experiments it appears that dried lichen contains 3 per cent. of bitter extractive matter, 33 of a matter insoluble in cold, but soluble in hot water, and 64 of a vegetable skeleton, which although insoluble in water has a great resemblance to hardened mucilage. It also appears that the method used by the Icelanders in dressing this herb is well adapted to its nature,

while that used by the Laplanders is wasteful and improvident.

The water in which the lichen is boiled is of a clear yellow colour, and slightly bitter. A lb. of lichen will cause about 8 lb. of water to gelatinize as fast as it cools. The gelly being left to itself the water separates from it on the edges; and if the vessel be inclined, the gelly splits in various places, and water oozes from these cracks, which shews how slight an attraction exists between the water and the gelatinous matter.

While this gelly is preparing transparent pellicles are formed on the surface, and it is probable that the greatest part of this principle might be thus collected. These pellicles driven down into the broth do not re-dissolve in it, at least, not unless the water is kept boiling, so that this appears to be the least soluble kind of mucilage in the vegetable kingdom.

The inspissated gelly of this lichen is by no means viscous, and has not the least disposition to form a glue or cement. When dried on plates it becomes divided into transparent, angular, brittle fragments, with a shade of deep red. This dried gum is not soluble in cold or even warm water, it only softens, and swells up, but without becoming gluey or glairy. It deposits whatever it retained of the bitter extractive matter, and hence becomes purer. Like the pellicles mentioned above, it requires water absolutely boiling to dissolve it.

The infusion of nut galls, which has no action upon vegetable gums, instantly forms a white curd with the gelly of lichen. This curd differs from that formed by nut-galls and isinglass by being soluble in water, and again separable by cooling.

The gum of lichen by distillation yielded water, acetic acid, oil in larger quantity than from gum or starch, some slight traces of ammonia, and about 23 or 24 per cent. of a carbonaceous residuum. It was converted easily into very white oxalic acid by the nitric acid, but yielded no tallow or yellow bitter principle.

The lichen itself dressed, and then dried, left on distillation only 21 or 22 per cent. of charcoal. It is quickly soluble in nitric acid, and yields oxalic acid, and oxalate of lime, the proportion of which appears to be augmented by some extraneous earthy matter. The residuum contained very little yellow bitter principle.

Purified potash converts dressed lichen into a gelatinous pulp, like that formed by the farinaceous substances in a similar experiment.

The gelly of the lichen may form an article of food, notwithstanding it contains some of the bitter extract, which may be easily disguised.

Prof. P. boiled four ounces of lichen in three pints of water till they were reduced to two. He then added a dram of flour to give some consistency to the gelly, and four ounces of sugar.

Sixty sweet almonds, 24 bitter ones, and a little citron peel were beat up with a little warm water, and then mixed with the gelly, which was then strained and cooled in small plates. This, he thinks, was equal to any *blanc manger* that is made, and it promises to be an excellent restorative. As long, however, as harts-horn shavings can be procured, it would be needless to apply to the lichen Islandicus for a basis of *blanc manger*. It is, however, evident from all that has been said, that we may consider this plant as a considerable resource in certain cases of necessity.

The gum of this lichen appears to be of a new kind, which, although it resembles starch in some respects, is very different in others. Georgi has found that other species of lichen are edible, and has shewn that the *L. physoides, hirtus, farinaceus,* and *pulmonarius* all yield a very mucilaginous broth, and that they may be eaten when seasoned with salt. It is well known that the rein-deer fattens on the *L. rangiferus,* and cannot bear the want of that plant. A variety of this last species found near Madrid yielded a little gelly which appeared to be of the same kind as that yielded by the *L. Islandicus,* but the plant itself did not become so tender.

Observations.—It is scarcely probable that the lichen will ever be adopted, at least in this country, as a common kitchen herb. It may, however, be adopted with success in the navy as a sallad herb for convalescents, or as a preventive for the use of those, of whom the incipient corpulency gives reason to suspect the breaking out of the scurvy.

To persons who are shipwrecked upon the inhospitable shores of the Atlantic or Indian oceans, which are near the poles, the knowledge of the nutritive quailties of lichen may be of considerable advantage, as those countries generally abound with plants of that genus. An acquaintance with the substitutes for the usual articles of food is, in such cases, of the utmost consequence. To render them, however, of more service it is necessary that they should either be found native in great quantity, or of quicker propagation, by culture, than our present esculents. Mr. G. Gray, presented, some little time ago, to the Literary and Philosophical Society, of Newcastle upon Tyne, some specimens of bread made of the root of the crocus vernus, and gave an account of his experiments upon the farina of that root as a substitute for that of wheat. Surely this can only be an object of curiosity, as neither the produce by culture, nor spontaneous growth, can ever be sufficiently great for ordinary use, or even for a resource in case of a famine overtaking us.

On a Fossil Horn. By Henry Braconnot.
Journ. de Phys. Août, 1806.

Four horns were found at Saint Martin, in the Department of the Meuse, in France, in a cave, a few feet under the surface. The horns were well preserved, two of them were smaller than the others; and they were accompanied with some portions of the skull. They were covered with a stratum of loam.

One of these horns was sent to Mr. Braconnot's uncle. This was only the osseous nucleus which connects the horns with the *os frontis*. It had a stony appearance, was porous, and externally of an ash colour. It was bent in the form of a semicircle, and directed downwards like those of black cattle. It was two feet one inch long, but the point only extended one foot and a half from the base, where it was one foot four inches in circumference, so that it must have been of a prodigious size when it was covered with its corneous covering. It probably belonged to one of the species called Bos Urus.

It had an earthy fracture, of the colour of wood, it stuck to the tongue, and smelled clayey. It was as easily pulverized as chalk, and then emitted a remarkable animal odour. Placed upon a hot coal, it became black. It was not fusible by the blow-pipe. Its powder when flung upon a heated iron became phosphorescent, and emitted an empyreumatic ammoniacal odour. Projected upon melted nitre, it detonated violently. When immerged in very dilute nitric acid, it effervesced briskly, and left a cartilaginous skeleton which retained the shape of the horn. Four per cent. also of ferruginous quartzose sand was left in the pores of this residuum.

The cartilage left by the action of nitric acid was voluminous and soft: it diminished by drying on the water-bath, became brittle, and of a brown colour. Water took up by boiling rather more than one half, which by the evaporation of the solvent was recovered in the form of a reddish transparent glue, soluble in water, and precipitating the infusion of nut galls.

The portion that was insoluble in water yielded, by distillation, a brown ammoniacal liquor of a sharp empyreumatic taste, some carburetted hydrogen gas, and a trace of carbonic acid gas, a carbonaceous residuum was left, this yielded some sand by incineration, but only iron could be separated from the sand by muriatic acid.

Caustic potash has a slight action on this insoluble portion of the cartilaginous skeleton, as acids produce red light flakes in the filtered liquid. Oxygenized muriatic acid destroys the brown colour of this liquor, and throws down very light white flakes.

By a long digestion the nitric acid dissolves a little of this, but no yellow matter is produced. The solution does not precipitate solution of glue. Whence it follows that this animal part of fossil horn has a considerable analogy to the bitumens.

The portion originally taken up by the dilute nitric acid, yielded a precipitate by prussiate of potash, and afterwards let fall phosphate of lime, by the addition of ammonia. This phosphate is not the same as is contained in the fossil horn, for this latter yielded to boiling water an acidulous phosphate that reddened tincture of litinus very sensibly. The precipitated phosphate was boiled in caustic potash, it yielded an ammoniacal odour, and the solution, when separated from the phosphate, let fall, by the addition of ammonia, some alumine united with a trace of lime. The phosphate of lime was then boiled in distilled vinegar, and the filtered liquor precipitated by adding carbonate of potash in excess, which flung down some carbonate of lime: and the supernatant liquor, by boiling, afterwards yielded some flakes of carbonate of magnesia. The phosphate from whence this magnesia had been extracted was treated in the same manner with sulphuric acid, and some more carbonate of magnesia, containing a little carbonate of lime, was obtained.

These fossil horns, by being pulverised and boiled in water, afforded a solution that did not exhibit any signs of gelatine by the addition of the infusion of nut-galls; neither did it render syrup of violets green, or produce any change in nitrate of silver. But the decoction slightly precipitated nitrate of barytes, and was itself precipitated by oxalate of ammonia, so that the horn still retained sulphate of lime.

By treating some of the horn with water in Papin's digestor, no gelatine could be extracted, but only the sulphate of lime. The same horn being afterwards digested with weak nitric acid, and then boiled in water, gave a solution which coagulated with decoction of nut galls into a white mass. Hence it appears that the proportion of gelatine contained in fossil bones and horns being diminished, the remaining portion is retained by the action of the mass of the phosphate of lime which forms the basis of these substances, so that it is not discoverable by simple decoction. Vauquelin has observed that the warm mineral waters of Plombieres, and of Deux, contain gelatine in such great quantity that it is deposited in the basins as they cool, and may be collected upon a sieve. It is, therefore, probable that this gelatine has been extracted from beds of fossil bones or horns: the heat occasioning a new series of attractions, and thus causing the phosphate of lime to part with some of the gelatine it before retained.

The fossil horn, calcined in an open vessel, lost 20 per cent. of its weight, and became of a very fine blue colour with spots of oxide of iron. The analogy of this colour with that of the tur-

quois, led Mr. B. to endeavour to discover whether the turquois really contained any copper. To this end he dissolved a small one in muriatic acid, but sulphureted hydrogen (although the most sensible test of the presence of copper) did not discover any signs of copper; the prussiate of potash shewed that some iron was contained in the gem.

The calcined horn reduced into very fine powder, and dissolved in distilled vinegar, yielded a solution that let fall, by the addition of carbonate of potash, a precipitate of carbonate of lime. The supernatant liquor, by the addition of nitrate of quicksilver, shewed some traces of phosphoric acid, and, by boiling, it let fall some flakes of carbonate of magnesia.

As posphate of lime varies in the proportion of its elements, it was important to discover the proportion of phosphoric acid and of lime that was contained in the phosphate which formed the basis of the fossil horn. One hundred parts of the horn calcined, and deprived of carbonate of lime by means of distilled vinegar, were dissolved in nitric acid; five parts of a bluish-black powder were left undissolved. Prussiate of ammonia produced scarcely any change in the solution, so that it is probable that, during the calcination, the iron abstracted a portion of the phosphoric acid from the phosphate of lime, and thus formed a phosphate of iron which coloured the calcined horn, and was insoluble in weak nitric acid. The 95 parts dissolved in the nitric acid were precipitated by oxalate of ammonia: the supernatant liquor was evaporated to dryness, and the residuum ignited in a crucible which had been previously weighed; by this means 38.7 parts of vitreous phosphoric acid were procured. The precipitate formed by the oxalate of ammonia, after being heated to redness, was entirely soluble in distilled vinegar, from this solution carbonate of potash flung down a precipitate which, by calcination with a strong heat, left 56.3 parts of lime.

From the experiments which have been made on this fossil horn, it appears to consist of 4 per cent. of ferruginous quartzose sand, 4.6 of solid gelatine, 4.4 of bituminous matter, 0.5 of oxide of iron, 0.7 of alumine, 1 of phosphate of magnesia, 11 of water, 4.5 of carbonate of lime, and 69.3 of phosphate of lime with a trace of sulphate of lime: the phosphate being composed of 28.3 parts of phosphoric acid and 41 of lime.

This horn, when calcined, did not exhibit any signs of fluoric acid by treatment with sulphuric acid.

Observations.—Mr. B. collects together a short account of some of the largest horns that have hitherto been found; but it is needless to follow him through this detail. It is sufficient to take notice of one remarkable circumstance, namely, that, in most instances, the horns, like those now treated of, have lost their horny covering, although this, which is of the same nature as

hair, offers a much greater resistance to the injuries of time, than the boney matter. Hence, it is probable, that as, according to the relation of Julius Cæsar, the ancient inhabitants of Europe affixed a great value upon this horny covering, for the purpose of forming cups from it, the greatest part of these horns have been deprived by them of this covering, and we now find only the bones which they left.

On the Production of Muriatic Acid, by the Galvanic Action. By Professor VEAU DE LAUNAY.—*Journ. de Phys. Aout.* 1806.

SINCE his former memoir on this subject, (see vol. ii. p. 470.) the experimental class of the Galvanic Society at Paris has repeated several times the experiments of Pacchioni and Brugnatelli; and have constantly obtained muriatic acid at the zinc end of the pile. Sometimes in operating with a gold wire, the acid had a strong odour, and was of a yellow colour. The Professor has also obtained the same result in his own elaboratory with Alizeau's pile of only 70 plates. It is more than a year since he has been convinced of this interesting discovery.

In the last experiments made at the Arsenal, at Mr. Riffault's, the apparatus was covered with a glass which preserved it from the contact of the air surrounding the pile. The success seems to depend principally upon the number of the plates, and their brilliancy: the size of the plates has little or no effect in the production of muriatic acid.

On the Heating of Water, during its Decomposition by the Galvanic Power. By Mr. JOHN TATUM, *Jun.*—*Phil. Journ.* No. 66.

IN preparing for a public lecture, two troughs of 26 plates were used, each plate containing 50 inches; and two troughs of 25 plates, each plate containing 36 inches: of course the whole power was 4400 inches. Nitrous acid diluted with 16 times its weight of water was used; and on passing the galvanic fluid through about an ounce of water, the temperature of the tube which contained the water rose to about 180° Fahr. On attempting to ascertain the temperature more exactly, by the use of a thermometer, the platina wires were accidentally brought into contact with each other, the gases exploded, and the tube, being forced up to a considerable height, fell, and was broken.

At the delivery of the lecture, this circumstance was mentioned, and some of the auditors, applying their hands to the tube in which the water was decomposing, hastily withdrew them on account of the heat. It is therefore probable, that the galvanic fluid furnishes more caloric than is necessary to convert the water into gases.

Observations.—In our last number, we noticed the brilliant discoveries of Mr. Davy, on the action of the galvanic fluid upon water, and we wait with impatience for the publication of his Bakerian lecture, in order to lay a full detail of his discoveries before our readers, and until then, we think it most prudent to refrain from any further observations on the subject. We cannot, however, refrain from observing, but on the sole authority of an anonymous note inserted in Tilloch's Philosophical Magazine, for February, 1807, that the two papers, by W. Peel, of which we gave an account in our first volume, p. 182, and our second volume, p. 83, were impositions on the public, by a person who pretends to be a chemist. At the same time, that we heartily agree with Mr. Tilloch in the strictures he makes upon such unprincipled conduct, if it be true, we must at the same time observe that the authority of an anonymous letter is but slight, and that the writer of it ought at all events either to have given his name, and the circumstances on which he founds his charge, or else to have exhibited well authenticated experiments to disprove the assertions made by the person calling himself W. Peel.

On the Discovery of the Inflammable Gas from Coals. By Mr. John Webster.—*Phil. Journ.* No. 66.

In the British Museum, there is preserved a paper (Ascough's Cat. 4437) entitled, "Experiments concerning the Spirit of Coals, in a letter to the Hon. Mr. Boyle, by the late Rev. James Clayton, D. D. B. Mus." These experiments were undertaken by him, in consequence of his having observed that the gas, issuing from certain fissures near a coal pit at Wigan, in Lancashire, took fire, when a burning candle was presented to it. He therefore distilled coal, and obtained first phlegm, afterwards a black oil, and then "an inflammable spirit," which he collected in bladders. By pricking these bladders, he was able to ignite the gas at pleasure. Hence it is evident, that the discovery of the carburetted hydrogen gas took place previous to the year 1664.

On the Carburetted Hydrogen Gas, procured from Coals, by Dr. Clayton, early in the last Century. By Mr. Home.—*Phil. Journ.* No. 67.

In the forty-first volume of the Philosophical Transactions, p. 59, is a sheet-paper which appears to have been read before the Royal Society, in January 1739, as "a Letter to the Hon. Robert Boyle, from the late Rev. John Clayton, D.D.;" in which is described how the discovery originated, and also some of the effects produced by this gas, or "spirit" of coals.

This letter may have been copied from the one mentioned by Mr. Webster, notwithstanding the difference in the Christian name. At any rate, the merit of this discovery can be no longer claimed by any person living.

Observations.—On the subject of these papers, we refer our readers to our remarks on Mr. Heard's patent for obtaining inflammable gas from pit coal, which is in a subsequent part of our present number.

Experiments on Palm Oil By John Bostock, *M. D. Phil. Journ.* No. 67.

Palm oil is of a deep orange colour, a little harder and less unctuous than butter; its odour is peculiar, aromatic, and not unpleasant. It was easily ignited by means of a cotton wick, and burned with a clear bright flame.

A portion of it was heated to 100° Fahr. and left to cool gradually. At 69° the oil began to be slightly opake; at at 62° it was completely opake, and of the consistence of honey; at 45°, its fluidity was entirely lost, but it retained a degree of softness it did not possess before it was melted. The movement of the thermometer both in the heating and cooling of this oil was uniformly regular. It also appeared that thermometers immerged in palm oil and in olive oil, which had been heated to 100° and left to cool, descended with equal rapidity.

Alkohol, at the ordinary temperature of the atmosphere, only becomes tinged, by palm oil, of a yellow colour; the solution is rendered slightly turbid by water By the application of heat, a greater quantity of oil is taken up, part of which separates on cooling; about $\frac{1}{7}$ remains in solution, and may be precipitated from the alkohol by water.

Sulphuric ether forms, with ease, a deep, bright, yellow solution, containing about $\frac{1}{4}$ of oil, by heat more is taken up. When water was added, the ethereal solution floated, but was not decomposed.

Oil of turpentine readily dissolves palm oil in the cold.

Caustic potash forms, by boiling, with palm oil, an opake and semi-fluid soap, which, when slowly decomposed by an acid, lets go the oil in small flushes, with the loss of its colour and smell.

Ammonia produces nearly the same effect with palm oil; which has, in fact, less attraction for these alkalies than olive oil.

The mineral acids do not dissolve palm oil, it floats on their surface, and when the acids are afterwards saturated by an alkali, no precipitation takes place.

The oil which had been treated with sulphuric acid lost its smell, became of a gray colour, and less unctuous than before. Boiling water separated it into two distinct substances: one white and friable, which had lost its oleaginous nature and was

diffused through the water; the other was small drops of a blackish oil.

Palm oil heated in contact with nitric acid became dirty, firmer than usual, and smelled like melted wax. A quantity of this oxidized oil was melted at a temperature of 110°, and was then gradually cooled; it became opake at the edges at 72°; at 69° it had entirely lost its transparency, and at 65° the thermometer could scarcely be removed from it; 100 grains of alkohol dissolved nearly three of this oxidized oil, and of these about two were precipitated as the solution cooled. Its solubility in potash was also increased; for boiling palm oil, and oxidized palm oil with twice their weight of potash; the whole of the oxidized oil was dissolved, and formed a thick soap, but a considerable proportion of the common oil floated on the surface of its mixture.

Whether the palm oil was boiled with nitric acid, or digested with it for some weeks, at the temperature of the atmosphere, or precipitated from potash by the nitric acid, the effect was nearly the same. By digestion without heat, the oil was first changed to a dirty green, then to gray, and lastly rendered white. The oxidized oil was not altered by being kept in boiling water, nor did it render the water acid.

In order to compare it with the bodies to which it has the greatest analogy, the following two series of experiments were made, one on the fusibility (or more properly speaking, the freezing points) of the several oily bodies, the other on that solubility in alkohol.

Tallow heated to 120° was perfectly fluid and transparent.

At $90\frac{3}{4}$° a slight tendency to opacity was just perceptible.

At 97° it became opake round the edges.

At 90° it was no longer transparent.

At 89° it had acquired a pretty firm consistence.

The thermometer descended equally during the whole time of cooling.

Spermaceti heated to 120° was perfectly fluid and transparent.

At 114° a slight opacity was perfectly perceptible at the edge.

At $112\frac{1}{4}$° the thermometer became stationary, a film was formed in the surface, and very nearly the whole was rendered solid, at which time the thermometer began to descend again, but on agitating the part that remained fluid, the thermometer rose again to its old station, till the whole had concreted.

Myrtle wax was melted by a heat of 120°.

At 116° it began to opake.

At $109\frac{1}{4}$° the thermometer became stationary, until the whole was rendered solid.

Bleached bees wax was melted.

At 148° it shewed a slight opacity.

At 142° or $141\frac{3}{4}$° the thermometer became stationary.

The wax, however, retained a degree of softness at a much lower temperature.

Hence with respect to their fusibility, the oily bodies will stand in the following order—expressed oil, butter, palm oil, tallow, myrtle wax, spermaceti, and lastly bees-wax. Dr. B. had not an opportunity to examine the freezing of expressed oil; but butter, palm-oil, and tallow, pass from the fluid to the solid state in a gradual manner, the others have a distinct freezing point.

To examine the action of alkohol upon the concrete oily bodies, they were added to boiling alkohol, until a part remained undissolved. When the whole was cooled, the undissolved part was taken away, and that which had precipitated by cooling, was separated by filtration; the solution was evaporated without heat, and the residuum weighed.

100 Grains of alkohol dissolved,

52. of spermaceti, half of which precipitated by cooling.

2. 134 of myrtle wax, 1.334, of which was precipitated.

0. 31 of bees-wax, almost half of which precipitated.

Expressed oils, butter, and tallow were also soluble in boiling alkohol, and a part precipitated as the solution cooled, the remainder was separable by water, or evaporation; but the quantity was so small as to render it difficult to ascertain its proportion.

The resins differ considerably among themselves as to their fusibility, and their solubility in alkohol: in general they are less fusible, and more soluble in alkohol, than any of the above-mentioned bodies.

It appears then, that palm oil differs eminently in its physical and chemical properties from any substance that has hitherto been made the subject of experiment. Its fusibility is nearly similar to that of animal fat, but, in its chemical properties, it more nearly resembles the resins, at the same time it differs from them in not being soluble in nitric acid.

Observations.—The palm oil sold in London is almost constantly a mere factitious compound; which is the more to be regretted as the genuine oil is one of the best remedies, when used externally, for coagulated milk in females, and far superior to ammonia or diluted alkohol for that purpose.

On the Mineralogy of the Island of Ceylon. By Mr. Jouville—*Phil. Mag.* No. 102.

The gems have not yet been discovered in their matrices, there being no others in the market than such as are found in currents. Corundum has, however, been found in a lengthened pyramid, and spinelle in small octaëdra. The mountains are every where covered with such abundant vegetation, that the mineralist finds it impossible to make any researches among them.

Neither granite, nor porphyry, has been found in Ceylon. The apparent base of the mountains is gneiss, which often contains

large plates of mica, two or three inches in diameter, and sometimes no mica at all. The felspar is often very abundant, but never in the form of determinate crystals. White and milky quartz is common, and they are sometimes found in masses of two or three feet thick. Large and clear rock crystals are also found in Ceylon.

The stone that covers the gneiss towards the sea-coasts, is a friable argillaceous stone, which is susceptible in great measure of being diluted with water ; it sometimes effervesces with acids, and contains a considerable quantity of the black, and red oxides of iron. It is called *kaloc* and is employed in building.

It is most probable, that the gems are found in the argillaceous veins of secondary matters, for if the gems were attached to the rocks, they would sometimes be found in the torrents attached to fragments of those rocks, but this is never the case.

Observations.—Although Mr. Jouville is a professed mineralist, has resided, we are told, seven years in the island, and has visited the interior, the information here given is remarkably scanty, and equally unsatisfactory.

On Gilding by Means of Zinc.—Phil. Journ. No. 66.

The gilt trinkets which abound in the shops are in fact only a coating of brass, formed by the precipitation of zinc upon copper, according to the following process. A soft amalgam is made of one part of zinc, and 12 parts of quicksilver ; if a little gold is added it will be so much the better. The copper trinket is carefully cleaned with nitric acid, and then boiled along with the amalgam in a mixture of muriatic acid and argol ; purified tartar will not succeed. The copper is thus finely gilt, and acquires such ductility that it may be drawn into wire as fine as a hair.

The theory of the above process appears to resemble that of whitening pins.

On Blacking for Leather.—Phil. Journ. No. 67.

In answer to an enquiry on this subject, the Editor of the Phil. Journ. observes that to render leather flexible, soft and impenetrable to water, and at the same time shining does not seem to be practicable. Oil, grease, and bees-wax with lamp-black or ivory-black, are principally used for the former purpose ; as sugar dissolved in beer or water along with the black pigment, has for the latter. The proportions are not of much consequence. Wax and tallow with lamp-black laid on before the fire, is probably the most useful blacking for shoes or boots intended to keep out water ; but where appearance is regarded, sugar is necessary.

On the Affinities of Bodies for Light, and particularly upon the refractive Powers of the different Gases. By Messrs. Biot *and* Arrago—*Bibl. Brit.* vol. xxxii.

Light, in passing from one transparent medium to another of a different density or chemical nature, undergoes a deviation from its path, which is known by the name of refraction. This refraction was shewn by Newton to arise the attraction that exists between light and the particles of gross bodies : an attraction that resembles, or is in fact the same as the chemical attraction that takes place between the elements of bodies, inasmuch as it acts only at small distances. It was the intention of the authors to employ this refraction of the rays of light in order to investigate the chemical composition of the several gaseous bodies.

To investigate the refraction of common air, two methods might be employed. The first, by comparing the positions of the stars as affected by the refraction of the atmosphere, with their position as found by calculation. The second is analogous to the method made use in finding the refracting powers of liquids and solids, which consists in causing them to be terminated by two plane surfaces oblique in respect to each other, and then observing the deviation which the rays of lights undergo in passing through those surfaces.

Newton had desired Hawksbee to make some experiments of this kind ; but they were left imperfect, on account of the imperfections of the apparatus. The Chevalier Borda had also undertaken this task, but he died before he had terminated his labour, and only some slight notices of them have been recovered : but the authors employed the same prism as was used by him.

This prism is a brass tube, terminated by two planes of glass, carefully cemented to the tube, oblique to the axis thereof, and inclined so as to form an angle of 143° 7′ 23″, between themselves. This tube is supported upon a stand furnished with a stop-cock, by means of which, a vacuum may be made in the tube by an air-pump. A barometer communicates with the tube, in order to ascertain the density of the air or gas contained in it. A small want of parallelism was discovered in the two surfaces of each of the glasses, which error amounted to 16.6. This error was therefore constantly allowed in relating the results.

The apparatus was placed on the top of the palace of the Senate, formerly the Luxembourg, a repeating circle was placed behind it, the lower eye-glass being constantly pointed to the electrical conductor of the observatory, 1400 metres (or about 4600 feet) distant. The variation of the visual ray when traversing the prism, was very exactly observed for a great number of times, to take advantage of the property of the repeating circle. At the

same time an account was kept of the variations of the barometer and of the thermometer.

The specific gravity of the gases was ascertained by weighing them in a glass globe previously emptied; and the authors not only corrected the weight obtained by observing the barometer and thermometer, but they also observed the moisture of the air as shewn by the hygrometer, because the vapour of water being lighter than air as 10 to 14 at equal pressures, it was necessary to have regard to this circumstance. All the weights were reduced to what they would have been at the freezing point, and with a pressure of 0.76 metre. The dilatation of glass was also allowed for, being estimated according to some unpublished experiments of Lavoisier and De la Place at 0.0000262716 of its volume, for each degree of the centigrade thermometer.

The globe was also filled with pure water, and its weight ascertained at 4° or 39°.2 Fahr. Great pains were also bestowed upon investigating the relation between the weight of air, and of quicksilver, as several useful problems depend upon it. After making every correction, the constant co-efficient to be employed in the calculations of the measurement of heights by the barometer, as expressed in metres, is 18332, at the freezing point, and the pressure of 0.76 metre. This co-efficient differs only by a very minute proportion from the co-efficient indicated by Ramond, viz. 18336 as found by comparing the barometric measurements with the heights as determined by levelling, or by trigonometrical operations; and which (it has been shewn by Ramond) would, if introduced into the formula of De la Place, give the heights of mountains as determined by the different methods, in a manner very nearly corresponding to one another.

The gases made use of were submitted to analysis, in order to determine their purity.

By the knowledge of the specific gravity of the aeriform fluids, and the refraction they caused the light to undergo, the authors calculated their refractive power, compared with that of atmospheric air. By refractive power, the authors do not mean the deviation solely of the luminous ray, but the sum of all the actions exercised by the body multiplied by the element of space, and by the density. They found that of aeriform fluids, oxygen refracts the least, and hydrogen the most; the refractive power of the latter being $6\frac{1}{2}$ times more than common air. The refractive power of the other gases is intermediate between that of oxygen and hydrogen. Notwithstanding the great difficulty that attended the investigation of the refractive power of muriatic acid gas, they successfully performed the experiment, and found its refraction to surpass that of the atmospheric air.

By varying the density of the common air, and of the other gases, Messrs. B. and A. discovered this important principle in the theory of refractions, namely, that from the most perfect vacuum to the ordinary pressure of the atmosphere, the refraction of the light,

in any given aeriform fluid, is always proportional to its density. But they have not yet examined the influence of temperature, and of the condensation of the air beyond the ordinary pressure of the atmosphere. The variations indicated by the hygrometer did not appear to have any appreciable effect upon the refractive power when the sky is clear, and the air transparent. As to the alteration produced by the existence of vapours in the air, they mean to investigate it when the great heats in summer allow them to operate with high temperatures.

In order to reduce the aeriform fluids to the same pressure and the same temperature, they made use of the law laid down by Gay Lussac, that the dilatation of every aeriform fluid is alike equal to 0.00375 of its volume, for each degree of the centigrade thermometer.

The action of bodies upon light is not indeed exercised in a sensible manner, except, at a very short distance, but it has a peculiar advantage, which is not to be met with in any chemical experiment. The intensity of the action of bodies upon light is so great, that it impresses upon it, even in an infinitely small instant of time, a velocity far greater than before, and always modifies it in a sensible manner, even in bodies of the weakest refractive power.

This great velocity, and the extreme tenuity of light, give it a further advantage, in that the greater or less degree of condensation of the constituent principles of a body, have very little influence upon its refractive power. In almost every case, the refractive power of the compound is equal to the product arising from multiplying the refractive power of each principle, by the quantity of that principle which enters into the combination. Thus the refraction of common air is exactly equal to the estimated refraction of a mixture of 0.21 of oxygen (in volume) with 0.787 of azote, and 0.003 of carbonic acid gas.

The same law holds in those combinations where the condensation is not very great. Hydrogen has, as we have said, a very powerful action upon light, and we may infer that it is the presence of this principle in water, gum, oils, &c. which is the cause of their great refractive power. This influence of hydrogen is eminently conspicuous in ammoniacal gas, whose refractive power is double that of air, and surpasses that of water. In the formation of this gas, the azote and hydrogen are reduced to $\frac{1}{2}$ of their separate volumes, yet the refraction is exactly what agrees with a mixture of 0.805 in weight of azote with 0.195 of hydrogen.

As to the refraction of water, in which substance there is a strong combination, and a great increase of density, there is a slight difference, which may arise either from the imperfect manner in which Newton made his experiment, or from the condensation. The refractive power of water, as calculated from the refractive powers of its component elements, is 1.50, that of atmospheric air being stated as 1.0. But, according to Newton, and employing for the mean refraction that of the yellow rays, it is 1.73.

It was of importance to determine the refractive power of muriatic acid gas, in order to estimate the value of some hypotheses which have been proposed concerning that acid. It was found to be rather superior to that of azote; a manifest proof that it is not a compound of azote and oxygen, since the presence of oxygen would cause the refractive power to be less than that of azote. And as its refractive power is less than that of water, it cannot, for the same reason, be an oxide of hydrogen less oxygenized than water.

The refractive power of carbonic acid gas is a little less than that of the atmospheric air, and a little greater than that of oxygen. According to the analysis of Lavoisier the gas is composed of 0.76 in weight of oxygen, and 0.24 of carbone: hence the refractive power of carbone may be calculated at 1.44, that is to say less than that of water. If less oxygen is contained in it the refractive power of carbone would be still weaker.

This refractive power, assigned to carbone, differs widely from the refractive power assigned by Newton to the diamond, viz. 3.2119; notwithstanding the diamond is usually looked upon as pure carbone; it therefore became necessary to investigate the refractive powers of such substances containing carbone as had been accurately analysed.

Olive oil is composed, according to Lavoisier, of 0.21 in weight of hydrogen and 0.79 of carbone, hence calculating on the preceding statement of the refractive power of carbonic acid, the refractive power of olive oil would be 2.50. The actual power, according to Newton, is 2.73.

Alkohol, according to Lavoisier, is composed of 0.544 of oxygen, 0.166 of hydrogen, and 0.290 of carbone. Hence the refractive power of alkohol, by calculation, would be 1.94; but, according to Newton, its power is 2.23.

Gum arabic, according to Fourcroy and Vauquelin, is composed of 0.6538 of oxygen, 0.1154 of hydrogen, and 0.2308 of carbone. Hence its refractive power, by calculation, would be 1.63; but, according to Newton, it is 1.89.

In all these cases the difference may be explained in some measure by the effect of condensation. The want of analyses of other substances does not allow any further comparisons, but the refractive powers observed in the substances agree in some measure with what is indicated by the combined influence of their supposed elements. The refraction is strongest in those in which hydrogen predominates, weaker where carbone prevails, and still weaker where oxygen abounds. Thus ether refracts more than alkohol, oil of turpentine more than the fat oils. Again, carburetted hydrogen refracts less than pure hydrogen, and so much the less as the proportion of carbone is increased in it.

But the diamond presents a very striking exception, its refractive power being the double of that here assigned to pure

carbone; hence it may be suspected that the diamond contains hydrogen. Even allowing this, it would be necessary to suppose that it contained a third of its weight of hydrogen in order to explain, by the presence of that element, its great refractive power; but allowing the same difference as to the effect of condensation as in olive oil, alkohol, or gum arabic, still it must be supposed to contain a quarter of its weight of hydrogen. Messrs. B. and A. therefore request the chemists to examine the diamond, paying a particular regard to the existence of hydrogen in it.

The authors announce their intention of extending their observations to the other aeriform fluids, to liquids, and to the solid bodies, in order that the chemical analyses of transparent bodies may be verified by the observations of their refractive powers.

The results thus obtained seem favourable to the theory of the emission of light, for on this hypothesis we may easily conceive that the refractive powers of compounds ought to depend on those of their principles, and their relative mass. The small influence of condensation would only shew the prodigious relative distance of the particles of light as well as their extreme tenuity. But if we supposed with Huyghens that light is produced by the vibrations only of a very elastic substance, the relation between the refractive power of the compounds, and of its principles, is not so apparent: and the condensation, or dilation, of the mediums, ought necessarily to have a very considerable influence upon the waves of the light, particularly when, as is the case with water, the constituent principles are condensed into a volume two or three thousand times less than they had before combination.

The dispersion of light, which varies in general with the refractive powers of the medium, seems also connected with the chemical composition of bodies, and to arise from the unequal action of their molecules upon the light. This inequality might, perhaps, be investigated by a method somewhat similar to the present, but still more subtle. And by observing the dispersion that take place in liquids, we might infer the dispersion that would take place in the component parts if their density would allow its effect to be appreciated.

The refractive power of common air is of great influence in astronomy, and has been attempted to be determined by astronomers from the comparison of a great number of celestial observations. The refractive power, as determined by Mr. Delambre, from the comparison of more than 500 observations, is so nearly the same with that deduced from the experiments of the authors, that the difference would not give an eighth of a second upon the height of the pole at Paris.

As the experiments of De Mairy, Berthollet, Davy, Beddoes, and Gay-Lussac, all clearly indicate that the proportion of the

elements of common air is constantly the same in all parts of the world, and at all heights; and, therefore, it is plain that the refractive power is constantly the same, and, of course, that the tables of refraction, calculated by the mathematicians in Europe, extend to all parts of the world, provided the refractive power is not changed by the effects of heat.

Observations.—The hypothetical idea of the diamond being pure carbone, as asserted by the French chemists, was long ago combatted, but, upon other grounds, by Prof. Winterl. He also assigned hydrogen as the other constituent principle. We are informed that the National Institute has caused experiments to be made on this subject, but these have not yet been published.

The observations, in this memoir, are certainly of great importance, as they may afford a means of verifying, as the authors justly observe, the analysis of transparent substances, and thus correct the deficiencies of the balance, and the losses occurring in the reiterated manipulations of chemists; but for this purpose immense researches would be necessary. The subject, however, is peculiarly important, for should it be found that the refractive power of bodies, composed of ponderable elements only, is in the compound ratio of the refractive power of their component principles, we may fairly conclude the same as to the imponderable elements. Thus the observation of the refractive power would, in that case, afford a practicable method of determining the number and presence of the imponderable elements, and thus enable philosophers to decide upon the question that at present divides the chemical world, viz the elementary nature or composition of water, which is now assumed as a postulate by both parties, without any proof on either side. For as to the pretended proof of its composition, from the equality of its weight with that of the gases from which it may be obtained by combustion, on which the French build so much, this is of no value unless it were previously proved that no imponderable elements exist. But the existence of imponderable elements is allowed even by them, and, therefore, it cannot be affirmed whether the water is produced from the union of the ponderable elements of oxygen and hydrogen, or is merely deposited from them in consequence of changes taking place in the distribution of the imponderable elements, as in either case its weight must correspond with that of the gases operated upon. The refractive power of water is stated, by Biot and Arrago, to be less than that observed by Newton, a difference which they wish to explain by the condensation of the elements; but it does not appear that they have made any direct experiments upon the effects of condensation, and, therefore, we ought still to exercise the same philosophic caution and withhold our complete consent to the pneumatic theory of chemistry until some positive proofs are adduced in its favour.

The agreement of the refractive power of common air with that of the compound ratio of the refractive power of its component parts must also be acceded to with some distrust. The analysis of the air is stated to the ten thousandth part of its volume, although the most experienced English or German chemists would regard the determination of its component parts to the three hundredth part of its volume as a sufficient proof of skill in the operator. This arises in part from the want of considering, or to speak more properly, from an ignorance, (in nine instances out of ten) of the real value of decimals, and the indiscriminate use of them on all occasions, although highly improper in some cases.

Experiments on Molybdene. By CHRISTIAN FREDERIC BUCHOLZ. *Jour. des Mines,* No. 100. *Translated from the German.*

IT being a matter of dispute whether native molybdene was a metal, or a sulphuret, Mr. B. first examined this point.

Exp. 1. Very pure native molybdene, powdered, and then heated in a glass matrass, did not yield any sublimed sulphur, but only a slight vapour of sulphureous acid. It lost only $\frac{1}{2}$ per cent. of its weight.

2. The preceding molybdene was then boiled in nitric acid, of the specific gravity of 1.22. It dissolved in the acid, but not very fast. Muriatic acid was added to prevent the formation of sulphurous acid. The solution, being diluted and filtered, formed a precipitate with muriate of barytes; but the molybdenate of barytes was retained in solution.

3. Molybdenic acid was dissolved in muriatic acid, the solution was very rough and metallic, it did not precipitate muriate of barytes, but the subsequent addition of sulphuric acid immediately produced that effect.

4. Molybdenic acid was dissolved in ammonia, this molybdenate formed an abundant precipitate immediately in muriate of barytes. The precipitate was re-dissolved when muriatic or nitric acid were added to the mixture.

5. One hundred grains of very carefully picked native molybdene dissolved by boiling in a mixture of nitric and muriatic acids, and precipitated by muriate of barytes yielded 290 grains of sulphate of barytes. In another trial 288 grains of sulphate were obtained. Hence as 100 grains of sulphate of barytes contain 32.5 of sulphuric acid, and 100 of sulphuric acid contain 42.55 of sulphur, the molybdene evidently contains about 40 per cent. of sulphur, and 60 of metallic molybdene.

6. One hundred grains of native molybdene dissolved as above, the solution distilled to dryness, and the residuum treated with ammonia, was almost entirely dissolved. No more than 3-4ths of a

grain of silica, and 1-fourth of a grain of oxide of iron being left, in the form of yellowish flakes. It is probable that these substances were only accidentally mixed with the mineral examined.

For the purpose of making further experiments, Mr. B. obtained a quantity of molybdenic acid, by roasting eleven ounces and a half of native molybdene in a crucible placed obliquely in a furnace. Vapours of sulphurous acid were disengaged, and the mass became covered with a crust of very pure molybdenic acid. This crust was citron yellow while hot, and of a beautiful silvery white colour when cooled. The whole of the molybdene might have been converted into this acid, but the operation was stopped, as soon as the greatest part of the sulphur was volatilized, a quantity of molybdenic acid formed, and the mass, when left exposed to a less degree of heat, began to agglutinate and to melt towards the edges. Eight ounces and a half of a gray, brilliant, crystalline mass were obtained, which being pulverized was of a whitish gray: half an ounce remained adherent to the sides of the crucible. This roasted mass was pulverized, and digested with ammonia: two ounces remained undissolved. This residuum was boiled with nitric acid, and then again digested with ammonia. The ammoniacal solution became turbid, and of an ochre yellow colour; after some days it let fall oxide of iron.

7. Six ounces of the molybdenate of ammonia was evaporated to dryness, during which operation it exhaled an odour similar to that of vanilla. The residuum was pressed into a glass tube, and covered with powder of charcoal; the tube was placed in a crucible and supported by sand. When the ammonia was volatilized, the tube was closed with a chalk stopple, and the heat briskly augmented for half an hour. After which the mass was pretty compact, friable, copper-coloured, verging in some places upon blue, of a metallic brilliancy; it exhibited crystalline plates and weighed three drachms.

8. This reduced mass yielded a violet powder passing to the redness of copper; and when heated to whiteness for half an hour, while surrounded with charcoal in a crucible, it agglutinated in some places, but the internal part was still pulverulent, and unchanged in its colour.

9. Molybdenate of ammonia was exposed to a moderate heat, in a Hessian crucible, until the ammonia was evaporated: it was then covered with powder of charcoal, and the heat was augmented as much as possible, for half an hour. When the whole was cooled, it was violet brown, the lowest part was so compact, that it was not pulverized without difficulty; the powder was violet, and consisted of small crystalline scales of a metallic brilliancy.

10. Molybdenate of ammonia was exposed for an hour to the most violent heat. The mass was now more compact, than in the former experiments, the fissures were filled with more nume-

rous and more crystalline laminæ. The scales appeared like polished pinchbeck. Their specific gravity was from 4.5 to 5.67, the same as is usually assigned to molybdene; by exposure to heat in contact with the atmosphere, or to the action of nitric acid they yielded molybdenic acid, nevertheless subsequent experiments prove that they are only a peculiar oxide of molybdene, and that a complete reduction could not be obtained by this process.

11. Molybdenate of ammonia was mixed with olive oil, and the oil burnt off, it left a dark blue pulverulent mass, which was violet in some places. This was covered first with charcoal powder, afterwards with a layer of chalk in powder, and then exposed to a violent heat. By this treatment, an ash gray earthy mass was obtained, whose parts had very little adhesion to each other, and scarcely shewed any signs of fusion. It effervesced with nitric acid, and formed a reddish solution, which afterwards became milk white. Concentrated muriatic acid was added, and boiled to dryness, but no solution took place.

12. The preceding product, which weighed $3\frac{1}{2}$ drachms, was pressed into a small crucible, and exposed for an hour and a half to a heat capable of melting iron in three minutes. Its form or colour was not changed, its particles were only slightly agglutinated; no signs of fusion appeared, nor was its weight altered.

13. The same mass pulverised with six grains of charcoal was again exposed for an hour and a half to the most violent heat that could be excited. When the cooled crucible was inverted, the mass fell out without breaking, but it was friable between the fingers, and easily pulverized. No signs of fusion appeared, six grains were left adhering to the sides of the crucible, and the mass rapidly absorbed water.

14. Molybdenic acid, which had been melted, was exposed, for an hour and a half, surrounded with charcoal, to an intense heat; it formed an ash gray puffy mass, was still but slightly coherent, and lost 32.73 per cent. of its weight. It was acted upon by nitric acid, as the other masses obtained in former experiments. In another trial, the roasted molybdenate of ammonia was treated in the same manner, which yielded a similar product, and lost 28.89 per cent. of its weight.

15 The violet brown oxide, exposed for half an hour to a middling red heat, yielded an imperfectly reduced mass, whose surface only was gray, the internal part being unchanged. A second exposure to heat reduced it entirely with the loss of 28.03 per cent. of its weight.

From these experiments, it is evident that molybdenic acid may be easily reduced by the action of heat, with contact of charcoal.

16. Ten drachms of molybdenate of ammonia was ignited for half an hour, then covered with charcoal, and exposed for an hour to a most intense heat, a metallic mass was obtained of ash gray colour externally, but internally, and in the hollows,

of a silvery blue metallic aspect, these parts spread under the pestle, and acquired greater brilliancy, they scratched silver, nine penny-weights fine, but were reducible to a gray powder.

17. This matter was ground, pressed into a crucible, and exposed for an hour and half to a most violent heat. Its particles were simply agglutinated, but had not entered into a real fusion. At the bottom of the crucible, however, were found some small grains, of the size of a pin's head, of a metallic aspect, and of a silvery white colour. The lower half of the mass rubbed with a porcelain pestle assumed the same appearance. By exposing part of the same mass to a violent heat for two hours, a metallic button could not be obtained: but in another trial, with two ounces of the brown oxide, exposed for an hour only, to a most violent and equal heat, several small spheres were obtained, weighing one or two drachms each, of a white metallic aspect, and of much greater consistence than any of the former. By rubbing these spheres against glazed porcelain, they acquired a polish, and could scarcely be distinguished from silver: this polish remained untarnished for several days.

As the masses which contained the reduced molybdene absorbed water, it is difficult to determine the specific gravity of the metal. To obviate this, the masses were boiled in water, and then the specific gravity appeared to be in three trials—8.636, 8.490, and 8.615, of which the mean will be 8.611.

18. To determine the quantity of oxygen in the molybdenic acid, nitric acid was abstracted from 100 grains of native molybdene, and the residue ignited for half an hour: the molybdenic acid thus obtained weighed 91 grains, which, arising from the 60 grains of metallic molybdene in the ore, shews that the acid contains 34.06 per cent. of oxygen.

19. Nitric acid, poured upon the matter obtained by the decomposition of molybdenate of ammonia, effervesced strongly; on attempting to evaporate the acid, the mass flew on a sudden out of the vessel. In another trial made in a tall vessel, 100 grains of this oxide treated with nitric acid yielded 110 grains of molybdenic acid, which evidently shews that this mass was not thoroughly reduced molybdene.

One hundred grains of native molybdene was oxygenized by a mixture of muriatic and nitric acids, and the acids expelled by ignition; 90 grains of molybdenic acid were obtained. According to this proportion, the acid contains 33.39 per cent. of oxygen.

20 The molybdene which had been reduced by means of charcoal, in the 13th experiment, effervesced violently with nitric acid, and disengaged much nitrous gas: 100 grains absorbed 34 of oxygene, so that the molybdenic acid which was formed, contained 25.37 of oxygene. As during the evaporation, the matter changed from brownish yellow to whitish yellow, and on being dried became orange, and even blue where the heat was greatest, it was proba-

ble that some of the charcoal was combined with the metal, and had some influence in the proportion of oxygene that was absorbed.

21. The same change of colours, however, took place when the molybdene reduced without being ground with charcoal was used: but with this also an imperfect oxygenizement took place, until muriatic acid had been added to the nitric. The molybdenic acid thus produced contained 32.43 of oxygene. And in another trial, 100 grains of molybdenic acid, lost by exposure to a forge heat for an hour, 32 grains.

22. Metallic molybdene in a mass of moderate cohesion, and of an ash gray colour, exposed to a heat gradually augmented, became, by a low red heat of a brownish yellow, and speedily changed to violet passing into indigo. The piece being withdrawn and broke was still ash gray in the center, and the change of colour was gradually from thence to the circumference. Re-exposed to the fire for some time, the whole became blue, and formed with water a solution of the same colour. By a still stronger red heat, the metal began to burn, and when cooled, its external part was blueish white, between this and the centre it was blue passing into violet, and internally violet passing into blue, like the oxide obtained by heat from molybdenate of ammonia. As soon as the metal acquired a white colour on its surface, it was rendered too compact to be broken between the fingers. By exposing it to a still greater heat, the whole surface became covered with molybdenic acid, which at last melted.

23. Fifty grains of metallic molybdene pulverized, and calcined with a gentle heat, yielded a grayish blue oxide, weighing 55 grains, which was less soluble in water than the former blue oxide. The undissolved residuum weighed 20 grains, and was dark gray bordering upon brown. By repeating the calcination, more of the blue oxide was obtained.

24. Metallic molybdene was calcined as before, until an indigo oxide with a shade of gray was obtained, which began to burn here and there. This oxide was partly soluble in water, a copper-coloured residuum being left. As this residuum afforded a blue solution with fresh water, it was treated first, with a large quantity of water, and then to encrease the oxygenizing action of the water, the oxide was several times moistened with it, and as often a solution attempted with fresh water; until at length only 11 grains of brown oxide remained, from 200 of the metal.

This mode of procuring the blue oxide was very tedious. By decomposing a solution of molybdene in sulphuric acid, by an alkaline sulphuret, and then adding a little sulphuric acid; the precipitate that fell down is decomposed, and a blue solution is obtained: but when this solution is evaporated to dryness, neither the sulphuric acid, nor the alkaline sulphate can be separated from the residuum, which is also mixed with some sulphur. Alkalies indeed would separate a little of the oxide, when the solution was

concentrated, but still the solubility of this oxide renders it incapable of being washed upon the filter. An excess of alkali destroys the blue colour, and, therefore, it probably causes the metal to unite with a greater quantity of oxygen. When the brown oxide was dissolved in muriatic acid, the acid could not be separated from it, so as to leave a blue oxide; but the following experiments founded upon the fact, that a solution of molybdenic acid becomes blue by the contact of the greatest part of metals, were successful.

25. Twelve grains of metallic molybdene, and 24 grains of molybdenic acid were boiled in seven ounces of water; the whole was changed into the blue oxide, except about two or three grains.

26. One hundred grains of molybdenic acid, and 80 grains of brown oxide were triturated together, with the addition of water; the whole was then boiled with some more water, and formed a blue solution, a few grains only being left. When metallic molybdene is ground moist with the brown oxide, the greatest part of the mass is changed into blue oxide. The mixture being dry, and very pure water poured on it, an odour is disengaged nearly similar to that of oil of rosemary, somewhat approaching to that of camphor.

27. The solution of the blue oxide, being boiled to the consistence of a syrup, first became clear, and then of a deep steel gray colour, when cooled, it was deep bluish green of a bitter and metallic taste. Nothing was precipitated by cooling. A little muriatic acid restored the blue colour. The best process to obtain the blue oxide is to grind one part of metallic molybdene with two parts of molybdenic acid, (or three of brown oxide with four of the acid,) and to moisten the powder during the grinding. The grinding is to be continued, with a moderate warmth until the matter is very blue; eight or twelve parts of water are to be added, the whole boiled for a few minutes, and then filtered. This process is to be continued as long as any blue solution can be obtained. The solutions are then to be evaporated by a heat of 30° or 40° Reaum. To prevent the blue oxide from becoming green, then yellow, and at length changing into molybdenic acid by the atmospheric air during a too slow evaporation, a little metallic molybdene or brown oxide may be placed in contact with the solution. This change of the blue oxide takes place more readily when potash or ammonia is present in the solution. The passage of ammoniacal gas through molybdenic acid changes it into blue oxide.

The blue oxide is in fact an acid, it changes blue paper to red, even more readily than the molybdenic acid, it effervesces and forms a blue solution with the alkaline carbonates. It preserves this acidity when it is changed into a bluish green oxide; and this oxide changes into blue by the addition of an alkaline carbonate.

28. Metallic molybdene was powdered, moistened with water, and the water slowly evaporated; fresh water being poured upon the residuum, a blue solution was obtained, and by a repetition of the process, the whole of the metal was changed into blue oxide, without passing through any intermediate state. The brown oxide afforded similar phenomena.

29. Concentrated sulphuric acid had no action in the cold upon metallic molybdene. By a moderate heat sulphurous acid was disengaged, and the liquid became yellowish brown. On diluting the solution with water it turned brownish yellow, and deposited a little undissolved molybdene, the supernatant solution changed to green, and afterwards to blue; and a portion of blue oxide was precipitated.

30. Nitric acid dissolved metallic molybdene, nitrous gas was disengaged, and a reddish solution was formed. This solution, digested upon metallic molybdene, became blue, and deposited the blue oxide. By evaporation it yielded molybdenic acid. By precipitation with ammonia, a brownish red precipitate fell, which, when washed and dried, yielded a powder of a lighter colour, mixed with brilliant white crystalline particles. This powder treated with a small quantity of water yielded a wine-yellow solution approaching to red. Small white crystals were left undissolved, which were much more soluble than molybdenic acid, and had a much rougher taste. The water with which the precipitate had been washed, was of a darker colour, as the precipitate was rendered more soluble by being wetted. Ammonia, or potash added to the solution, threw down a brown red precipitate, which was not dissolved by a solution of an alkaline carbonate, but the white crystals were dissolved with effervescence. The brown precipitate differs from the brown oxide obtained from the decomposition of the molybdenate of ammonia, for this oxide is insoluble in water. Neither does the precipitate yield blue oxide, by being treated with molybdenic acid, although it yields it with metallic molybdene. Hence, we may conclude, that it is more oxygenized than the blue oxide.

32. Muriatic acid, whether concentrated or diluted has no effect upon metallic molybdene.

33. Water, saturated with the vapours of oxygenized muriatic acid, formed a fine blue solution with metallic molybdene. Liquid oxygenized muriatic acid destroyed the colour of the solution, but the addition of more metallic molybdene restored the blue colour.

34. Metallic molybdene boiled in a solution of arsenic acid formed a blue solution.

35. Phosphoric acid had scarcely any action upon metallic molybdene.

36. The boracic, tartarous, and citric acid, have no action upon metallic molybdene. The succinic acid treated with it becomes

green when evaporated, but no other effect is observed to take place. Acetic acid boiled upon the metal becomes of a brownish yellow, but ammonia scarcely occasions any precipitation in the solution.

None of the solutions of molybene in acids can be considered as true salts on account of the acid nature of the oxygenized molybdene.

37. Native molybdene treated with a fixed alkaline ley was very sparingly soluble. The undissolved residuum did not yield sulphuretted hydrogen by the addition of dilute sulphuric acid. The ley had a strong smell of sulphurous acid, it yielded a great quantity of sulphuretted hydrogen, by means of dilute sulphuric acid, and let fall a yellowish brown precipitate, which appeared to be a hydrosulphuret of molybdene.

38. Native molybdene, treated with fixed alkali in the dry way, formed a deep crimson mass. This mass washed with water left a clear gray residuum. The solution itself was at first deep green, but by exposure to the air, it became of a blackish gray, it yielded sulphuretted hydrogen, by the addition of sulphuric or muriatic acid, and let fall hydrosulphuret of molybdene, the supernatant solution was blue. Nitric acid occasioned a similar precipitation, but the blue solution became first green, and then reddish yellow.

As it was probable that if the proportion of sulphur was increased, the potash might have more action on the sulphuret of molybdene, the following experiments were tried.

39. Ten grains of molybdene were boiled twice in half an ounce of liquid caustic potash (in which twenty grains of sulphur had been dissolved) to dryness. The molybdene was scarcely altered, but it yielded a deep green colour to water. Forty grains of sulphur was added, and the process repeated, but with no better success. The solution, when decomposed by sulphuric acid, let fall a grayish blue precipitate, very similar to lac sulphuris, and which contained some flakes of a yellowish gray.

40. Two drachms of alkaline ley, 30 grains of sulphur, and ten of molybdene, were heated together, evaporated to dryness, and then ignited. The mass yielded a fine yellowish red solution with water, and left only three grains of residuum. Sulphuric acid added to the solution threw down a blackish brown precipitate, which when washed and dried, was brownish black, and weighed forty-five grains. The supernatant liquor had not the least bluishness. This precipitate was not acted upon by sulphuric or muriatic acids, but was dissolved by the nitromuriatic acid, leaving a little sulphur. By heat 2-5ths of sulphur sublimed from it, the residuum was oxidized by the nitric acid, but this solution still contained a little sulphuric acid, hence all the sulphur had not been separated by sublimation. It is therefore evident that this precipitate was a combination of metallic molybdene, supersulphuretted hydrogen, and a slight excess of sulphur.

41. Sulphuric acid was poured into a solution of molybdenate of ammonia, until all the precipitate it occasioned was redissolved; and then hydroguretted sulphuret of ammonia was added, which threw down a reddish brown precipitate, the supernatant liquor was blue. If a little hydroguretted sulphuret of ammonia was added at first to the molybdenate, sulphuric acid did not throw down any precipitate, but only changed the solution blue; but if a larger quantity of hydroguretted sulphuret was used, the precipitation took place.

42. Molybdenic acid dissolved in the sulphuric was precipitated by the hydroguretted sulphuret of ammonia, of a chocolate colour, which when the precipitate was dry, changed almost to a black. An excess of acid did not decompose it, nor change it blue; hence it was similar to the native sulphuret.

43. Molybdenate of ammonia was supersaturated with sulphuric acid, and a solution of sulphuret of potash added, which threw down a clear reddish brown precipitate, the supernatant liquor was blue. If the molybdenate was only saturated with the acid, hydroguretted sulphuret of potash threw down a flesh coloured precipitate, approaching to copper colour. If no sulphuric acid was previously added, no precipitate was produced, but the liquid became a little milky; a subsequent addition of the acid threw down a reddish brown precipitate. All these precipitates were decomposed by an excess of acid, and yielded a blue solution, a brownish gray residuum, containing sulphur, and a little molybdene being left.

44. Sulphuretted hydrogen was passed through a solution of molybdenic acid, (or rather, as appears from the phenomena, of molybdenate of ammonia) which immediately became reddish brown, but still remained transparent. It smelt strongly of sulphuretted hydrogen, and yielded a black precipitate by muriatic acid. By exposure to air, it became turbid, opake, and of the colour of cow-dung. On boiling, it regained its transparency and colour, only it was somewhat yellower. The scum formed by the boiling was reddish yellow, and on being evaporated to dryness, it yielded ammonia. The dried residuum was chocolate colour; by heat it yielded ammonia, accompanied with the odour of sulphuretted hydrogen: afterwards it yielded sulphurous acid, and became bluish black. It was then insoluble in water, or even in an acid of middling strength. On being ignited, it yielded sulphurous acid, and left molybdenic acid. Another parcel, boiled in muriatic acid, yielded but little sulphuretted hydrogen, and formed a brownish yellow solution, which being diluted with water, became bluish green, and afterwards entirely green. A third parcel was first shook up in water, and then put into muriatic acid, this yielded plenty of sulphuretted hydrogen, and formed a blue solution, which soon acquired a shade of green, and let fall a blue precipitate which differed from the blue oxide of molydene, by being insoluble in

water. A fourth parcel of the residuum was found to be insoluble in cold water, but partly soluble when boiled in that liquid. The undissolved part was reddish yellow, the solution had the same colour as the preceding, it smelled strongly of sulphuretted hydrogen. Its odour was augmented by sulphuric acid, which also turned it first blue, and then green. Hence the chocolate coloured residuum is a triple combination of sulphuretted hydrogen, ammonia and molybdene. It exhibits the same effects with acids, as the precipitates obtained in the 38th, 41st, and 43d experiment. Roasting it brings it very near to the native sulphuret, but it seems to retain some sulphuretted hydrogen, and it is much easier changed into molybdenic acid.

45. Ten grains of molybenic acid was melted, pulverized, and boiled in ten ounces of water, the greatest part floated about undissolved. Sulphuretted hydrogen being passed through it, immediately changed the whole brown, and the acid was taken up, except a few brownish black flakes, the solution then became similar to the preceding in colour and odour. Twenty-four hours after, it became turbid, and let fall a yellowish brown powder, which by drying, became brownish black. The filtrated liquor was yellowish brown; on being boiled, it yielded sulphuretted hydrogen, and let fall a quantity of powder, the addition of muriatic acid produced a blue colour. The precipitated powder flung into muriatic acid exhibited the same phenomena as in the preceding experiment, but by boiling, a brownish yellow solution was at last obtained. This powder burnt with a transient sulphureous flame. Hence molybdenic acid may be combined with sulphuretted hydrogen, but this combination is not so strong as when ammonia is present.

46. Sulphuretted hydrogen was then passed through a solution of molybdenate of ammonia, to which a sufficient quantity of sulphuric acid had been added to redissolve the precipitate, which the acid threw down. The liquor became blue, and threw up a matter of a clear chocolate colour, which was speedily redissolved. It then became black, and yielded a precipitate of the same colour. The filtrated liquor became blue again on being boiled. The water with which the precipitate was washed was also slightly blue. The precipitate itself yielded a brownish yellow solution by boiling in muriatic acid. It burnt with a blue flame, but on the heat being suddenly increased, the flame ceased, and a quantity of sulphurous acid was disengaged. The residuum, which remained after it had been burnt with a blue flame only, was blackish brown, insoluble in water, by an increase of heat it was converted into molybdenic acid, and then gave a slight blue tint to water, becoming itself of a true black colour.

Observations. It appears that there is some mistake in the 44th experiment where molybdenic acid seems to have been inserted in-

stead of molybdenate of ammonia. The author, as is very usual among the German chemists, uses the name of hydrothionic acid for sulphuretted hydrogen, and hydrothionates for the compositions into which it enters; but we have preferred our own nomenclature. These experiments are important, and conduce much to our knowledge of the oxides, and other combinations of molybdene.

Analysis of the Slate which is found along with Menilite, near Paris. By LAMPADIUS.—*Journ. des Mines,* No. 106.

THIS stone is called by Werner *klebschiefer,* and has been confounded by several mineralists with the *polierschiefer* of that author. It adheres strongly to the tongue, it is pale yellowish grey, opake and dull. It is slaty with straight leaves, scraping produces a little brightness, it is very soft, and exfoliates of itself, a circumstance which is very characteristic. Its specific gravity is less than 2. It is found at Menil montant near Paris, having menilite imbedded in it.

It lost 30 per cent. by calcination, and became dark brown; it showed no signs of fusion, but became harder and less friable. Even in a clay crucible it became magnetic. By the blowpipe with oxygen it melted upon charcoal into an opake, glassy, blackish brown bead. By the common blowpipe it was infusible, and only a small portion was taken up by borax, which then became blackish brown. It was soluble with effervescence in muriatic, or sulphuric acid.

It was dissolved in sulphuric acid, and boiled to dryness. The exsiccated mass was washed with water, to separate a yellow gelatinous residuum. The solution being boiled deposited sulphate of lime, which was decomposed by an alkaline carbonate, and the lime thus separated. The remaining liquor was concentrated and yielded crystals of sulphate of iron, and of sulphate of magnesia; but these were not separated, the whole being evaporated to dryness, and then ignited for two hours, the exsiccated mass was ochre colour, and bitter, it was washed with boiling water, and left oxide of iron, on the filtre, carbonate of ammonia separated magnesia from the filtrated liquor. The former yellow gelatinous residuum was digested with muriatic acid, till the silica was left perfectly white; the iron which had been taken up was separated by ammonia.

By the analysis thus conducted, this stone was found to contain 28 per cent. of magnesia, 27 of carbonic acid, 30.8 of silica, 11.2 of oxide of iron, 0.8 of lime, 0.3 of water, a loss of 1.9 being sustained. Hence this stone contained more iron than its colour indicated, and no alumine notwithstanding its resemblance to slate.

Compound Gazometer for Purposes where uniform Pressure is essential. *By* Joseph Steevens, *Esq.*—*Phil. Mag.* No. 105.

It is scarcely possible to give an intelligible account of this very complicated machine without a plate, and, therefore, we refer such of our readers as are interested in it to the work mentioned above. The principal part of the apparatus is copied from Van Marum's double gazometer, and the uniform pressure is produced by means of Mr. Steevens' hydrostatic regulator described in the Phil. Mag. vol. xx. page 289, instead of the flowing of water from a regulated orifice, as in the original gazometer.

NATURAL PHILOSOPHY, ARTS, and MANUFACTURES.

Observations upon the Marine Barometer, made during the Examination of the Coasts of New Holland and New South Wales, in the years 1801, 1802, *and* 1803. *By* Matthew Flinders, *Esq. Commander of His Majesty's Ship Investigator.*—*Phil. Trans.* 1806, Part. II.

This interesting paper contains observations upon the movements and state of the mercury in the barometer on the coasts mentioned above, the Terra Australis of the earlier charts. The marine barometer with which these observations were made was constructed by Nairne and Blunt, and had been used in Captain Cooke's voyages. The height of the mercury was taken regularly at day-break, at noon, and at eight o'clock in the evening. The temperature of the thermometer was also registered at the same periods. The circumstance that led Captain Flinders to think his observations worth attention, was the coincidence that took place between the rising and falling of the mercury, and the setting in of wind that blew from the sea and from off the land, to which there seemed to be at least as much reference as to the strength of the wind or the state of the atmosphere.

Among the examples selected from the Captain's journals, are nine that relate to the *south* coast; from these it appears, generally, that a change of wind from the northern to any point in the southern half of the compass caused the mercury to rise, and a contrary change to fall; and that the mercury stood considerably higher when the wind was from the south side of east and west than it did in similar weather when the wind came from the north side.

As to the height at which the mercury stood upon the south coast; it was seldom down to 29.40, and only once to 29.42. Of 180 days from the beginning of December 1801, to May 1802, it was nearly one third of the time above 30 inches; and the second time of passing along the coast from May 15th to June 1st, it only once descended to 29.96, and that for a few hours only; its average standard for these 16 days being 30.35. Upon the eastern half of the coast in March, April, and May, the mercury stood higher than it did in the western half in December, January, and February: the average of the first was 30 09, but that of the latter only 29.94. At the Cape of Good Hope the mean height, during 18 days in October and November, was 30.07.

From a general comparison of the examples of winds on the *east* coast, it appears that those which came from between south and east caused the mercury to rise and stand highest, as they had also done upon the south coast, one example excepted. The winds from N. E. kept the mercury up above 30 inches on the east coast and caused it to rise after all other winds except those from the south-eastward: but on the south coast the mercury fell with them, and stood considerably below 30 inches; because, (as Captain Flinders concludes) they then came from off the land. During north-west winds the mercury stood lower than at any other time upon both coasts; and on both they came from off the land.

Moderate winds from the south-eastward, with fine weather, caused a descent of the mercury on the east coast; and during their continuance it was much lower than with winds from the north-eastward; but upon the south coast it rose with south-west winds, and stood much higher than when they came from the opposite quarter.

Although the height of the mercury upon the south-coast of Australia was, upon the average, considerably above the medium standard 29.50, it was still greater upon the east coast, it could not be less than 30.08, or 30.10; while upon the south coast it might be taken at thirty inches. The greatest range observed upon the east coast, was from 29.60, to 30.36 at Port Jackson; and within the tropic from 29.88 to 30.30, whilst upon the south coast, the range was from 29.42 to 30.51, in the western part, where the latitude very little exceeds that of Port Jackson.

The observations upon the north coast are but little satisfactory, both because the changes in the barometer were very small in so low a latitude, and because of the decayed state of the Investigator, which obliged Captain Flinders to return with all practicable expedition to Port Jackson.

On a due consideration of the effects of the same winds upon the different coasts of Australia the, following queries are presented with a view to the deduction of a plasible hypothesis.

Why do the winds from north and north west, which cause

the mercury to descend and stand lower than any other upon the south and east coasts, as also in the open sea, and in the south-west bight of the gulph of Carpentaria, make it rise upon the outer part of the north coast, with the same or even worse weather?

Why should the north-east wind, which occasions a fall in the barometer upon the south coast, considerably below the mean standard, be attended with a rise above the mean upon the east and north coasts?

The south-east wind, upon the south and east coasts, caused the mercury to rise higher than any other; why should it not have the same effect upon the north coast, and upon the west?

How is it that the south-west wind should make the mercury rise and stand high upon the south and west coasts, should cause it to fall much below the mean standard upon the east coast, and upon the north make it descend lower than any other, with the same weather?

The answer to these questions is in brief, this: the first portion of air brought in from the sea, is impelled upwards by the land which it encounters, and along the inclined surface of the land in a sloping direction: the next portion is, in the same manner, stopped and forced upwards; but it has a shorter space to pass through, because the former portion goes along two of the sides, and the latter along the third side of an obtuse-angled triangle: thus, the succeeding portions of air meet the summit of the land before the first portions, and cause the latter to eddy and stagnate; while the stream blowing above this portion, compresses it and augments its density, whence the increased height of the barometer. Similar reasoning, *mutatis mutandis,* applies to all the other phenomena.

Captain Flinders concludes with stating a few such general remarks upon the barometer, as may be useful to seamen. But we omit these, to make room for a passage, from which it appears that this skilful commander navigated his vessel in those dangerous parts of the east coast that are between the latitudes of 23° and 17°, pursuant to a confident deduction from his own theory. "The barometer, says he, was of great service to me in the investigation of this dangerous part of the east coast, where the ship was commonly surrounded with rocks, shoals, islands, or coral reefs. Near the main land, if the sea breeze was dying off at night, and the mercury descending, I made no scruple of anchoring near the shore; knowing that it would either be a calm, or a wind would come off from the land; but if the mercury kept up, I stretched off, in the expectation that it would freshen up again in a few hours. Amongst the barrier-reefs, when the wind was dying away, the barometer told me, almost certainly, from what quarter it would next spring up. If the mercury stood at 30.15, or near it, and was rising, I expected the proper trade wind; and if higher, that it would be well from the southward, or would blow fresh, and if it was up to 30.30 both. The falling of the mercury to 30.10

was an indication of a breeze from the north-eastward; and its descent below 30 inches, that it would spring up, or shift round to the westward." Captain Flinders, however, did not expect this regular connection between the barometer and the direction of the wind, to obtain so uniformly at a different season of the year; and was, therefore, too wise to prolong his stay among the barrier reefs.

Observations.—We esteem this paper as a considerable acquisition to meteorology, and would request our readers to peruse it attentively, in connection with the observations of Mr. Horsburgh, Dr. Balfour, &c. recorded in our fourth number.

The theory by which Captain Flinders accounts for the phenomena he has related is plausible. Yet we should hesitate long before we admitted it. A very easy method of verification was in the power of the Captain, namely, that of remarking the effects of different distances from the coast, and those of different kinds on shore; this method could not we should think but suggest itself to his sagacity; and we are therefore the more surprized that he does not notice it in his memoir. We would not, however, be understood, as meaning to convey any censure upon Captain Flinders, or as wishing to depreciate his paper: it is, in our opinion, peculiarly valuable, on account of the facts it exhibits. We record them with much pleasure; and can only hope that other navigators will follow the example of this truly ingenious gentleman, in carefully registering their meteorological observations in different latitudes and climates; that some master-hand may at length strike out a theory which may satisfactorily connect and elucidate the various results.

A new Demonstration of the Binomial Theorem, when the Exponent is a positive or negative Fraction. By the Rev. Abram Robertson, A.M. F.R.S. *Savilian Prof. of Geom. in the University of Oxford. Phil. Trans.* 1806, Part. II.

The object of Mr. Robertson is to exhibit a demonstration of this theorem, so important on account of its extensive utility in the higher analytics, upon the principles of multiplication alone, without calling in the aid of any principle foreign from the nature of the enquiry. He first shews that the product arising from the multiplication of any number of quantities, such as p, q, r, s, t, &c. into one another, continues the same in value, whatever variation may be made in the arrangement of the quantities which compose it. He then multiplies continually together the quantities $x+a=p$, $x+b=q$, $x+c=r$, $x+d=s$, $x+e=t$, &c. whence he obtains successively a quadratic, cubic, biquadratic, sursolid, &c. equation; and after pointing out the nature of the co-efficients and exponents, in the successive terms of each product, he supposes the quantities b, c, d, e, &c. to be each equal to a; on

which hypothesis the several co-efficients become powers of a; and if n be the index of any positive integral power, it is justly inferred that the theorem is $(x+a)^n = x^n + n\,a\,x^{n-1} + n.\frac{n-1}{2}\,a\,x^{n-2} + n.\frac{n-1}{2}.\frac{n-2}{3}\,a\,x^{n-3} +$, &c.

The theorem is then transformed into that which appertains to the n^{th} power of $1+x$, and is followed by another expressing the m^{th} power of $1+x$: these two series are then multiplied into each other, and the product ranged according to the powers of x manifestly give the series equivalent to $(1+x)^{n+m}$. This series is, for the sake of reference, called "multiplication A." Now with respect to the co-efficients prefixed to the several powers of x in this multiplication, two observations are made, by means of which the demonstration of the theorem is extended to fractional exponents. 1st. Supposing n and m to be whole numbers, the sum of the co-efficients prefixed to any individual power of x in multiplication A, must be equal to the co-efficient prefixed to the same power of x in the binomial series $1+(n+m)\,x+(n+m).\frac{n+m-1}{2}x^2+$&c. 2dly. That the whole co-efficient of any power of x, in the products of multiplication A, may be reduced to the regular binomial form. And in proceeding to change the form of the co-efficients prefixed to any power of x, in multiplication A, into the regular binomial form, there is no necessity to suppose n and m to be whole numbers; for the actual multiplications will end in the same powers of n and m, the same combinations of them, and the same numerals, whether n and m be considered as whole numbers or as fractions. From this process of reasoning the forms for $(1+x)^{\frac{1}{r}}$, and $(1+x)^{\frac{n}{r}}$, are inferred, and the same identity of composition is shewn to take place in the co-efficients of the respective terms.

The reasoning is then extended to $(a-b)^n$, to $(1-x)^n$, and $(1-x)^m$, and to the product of the last two series, called "multiplication B." The corresponding terms are shewn to be of the same nature, setting aside the alterations in the positive and negative signs, as those in multiplication A. In like manner, all the particulars essential to the demonstration of the binomial theorem are deduced; and it is shewn that whether the exponent of the power be positive, negative, integral, or fractional, the general formula is of the same species, and each of its terms is produced in a similar manner from the preceding.

Observations.—This demonstration in the way it is conducted by Mr. Robertson is excessively prolix: all the essential steps are the

same as those in the demonstration of Euler given in the Petersburgh acts for 1774, and afterwards published by Bossut and Lacroix in their respective treatises of Algebra, though in half the compass of the paper before us. The kind of proof is satisfactory in the main; but it is in our opinion inferior to the demonstration given by Manning in his algebra, in which he shews that if the law predicted in the binomial theorem obtain so far as any particular term, it must necessarily obtain in the next succeeding term, and consequently must obtain universally; and since it does actually obtain in the first terms, therefore it obtains universally. As to the order of the expanded series with regard to the powers of x, or indeed the theorem in general, it has received a very complete demonstration by Dr. Hutton in his Tracts, vol. 1. The demonstrations by Landen, and others, founded upon the expedient of vanishing fractions, need hardly be mentioned in this connection; the reasoning in most of them being fluxional, but under a very disadvantageous form.

New Method of Computing Logarithms. By THOMAS MANNING, *Esq.—Phil. Trans.* 1806, Part II.

MR. MANNING'S method possesses the advantage of forming logarithms with tolerable ease, *independently of each other*, by means of a few bases; while it is easy of application, requiring no higher arithmetical operation than subtraction. It is as easy for the logarithms of large numbers as for small, and in general $9 \times \frac{n+1}{2}$ subtractions, will give accurate results to $2n$ places of decimals.

In computing hyperbolic logarithms, by this method, the hyp. logs. of $\frac{10}{9}$, $\frac{100}{99}$, $\frac{1000}{999}$, &c. of 2 and of 10, must be previously known; these with their multiples up to the ninth, and those of the reciprocal of hyp. logs. to 10, or of the modulus of the common logs. are ranged in tables for reference. With respect to the logs. of $\frac{10}{9}$, $\frac{100}{99}$, $\frac{1000}{999}$, &c. they are, Mr. Manning remarks, the respective sums of the series,

$$\frac{1}{10} + \frac{1}{2}\cdot\frac{1}{10^2} + \frac{1}{3}\cdot\frac{1}{10^3} + \frac{1}{4}\cdot\frac{1}{10^4} + \&c.$$

$$\frac{1}{100} + \frac{1}{2}\cdot\frac{1}{100^2} + \frac{1}{3}\cdot\frac{1}{100^3} + \frac{1}{4}\cdot\frac{1}{100^4} + \&c.$$

$$\frac{1}{1000} + \frac{1}{2}\cdot\frac{1}{1000^2} + \frac{1}{3}\cdot\frac{1}{1000^3} + \frac{1}{4}\cdot\frac{1}{1000^4} + \&c.$$

These series being valued by approximation, the rules are as below :

I. *To find the Hyperbolic Logarithm of any Number not exceeding* 2.—Set the number under itself, to be subtracted from itself, but removed so many places to the right as shall be necessary to make the remainder greater than 1; subtract. Proceed in the same manner with the remainder, and so on till that remainder becomes 1 followed by $\frac{1}{2}$ as many cyphers as the number of decimal places you work to : suppose at the end of the operation you find that you have removed *one* place to the right and subtracted b times ; *two* places, c times ; *three* places, d times, &c. then $b \times \mathrm{HL}\frac{10}{9} + c \times \mathrm{HL}\frac{100}{99} + d \times \mathrm{HL}\frac{1000}{999}$ + &c. + decimal part of the last remainder = the hyperbolic log. sought. And the multiples of the respective HL's are all contained in the tables, as none of them can exceed the *ninth.*

II. *To find the hyp. log. of any number, whole or mixed* —Reduce the given number (if necessary) to a whole or mixed number less than two, by setting the decimal point after the first significant figure, or if the given number be 10, or a power of 10, after the first 0 : and then dividing by 2 (if necessary) till the integral part is 1. Three divisions by 2 will always suffice.—Find the hyp. log. of this reduced number by the last rule, and add to it or subtract from it as many times the hyp. log. of 10, as the decimal point was removed places to the left or right ; also add to it as many times the hyp. log. of 2, as there were divisions by 2. The sum is the hyp. log. required.

III. *To find the common log of any number.*—Find the hyp. log. by the above rules, and multiply the reciprocal of hyp. log. 10 into it. *Otherwise,* proceed by Art. 2. omitting what concerns the hyp. log. 10, multiply into reciprocal of hyp. log. 10, and add or subtract as many units as the decimal point was removed to the left or right.

The demonstration of the above rules is obvious. Setting the figures of a number 1, 2, 3, &c. places to the right, and subtracting, is equivalent to subtracting the $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{10000}$, of the number from it, or obtaining its $\frac{9}{10}$, $\frac{99}{100}$, $\frac{9999}{10000}$, &c. If b, c, d &c. denote as in the rule; then the original number $= \left(\frac{10}{9}\right)^b \times \left(\frac{100}{99}\right)^c \times \left(\frac{1000}{999}\right)^d \times$ &c. $\times$ last remainder. Therefore the log. of the original number $= b \times \mathrm{L}\frac{10}{9} + c \times \mathrm{L}\frac{100}{99} + d \times \mathrm{L}\frac{1000}{999}$ + &c. + L of last remainder. Now, the last remainder being unity followed by a certain number of decimal cyphers, its correct hyp. log. as far as twice that number of places, is (as is well known) the decimal part itself of that remainder. Hence, the rule is manifest.

A similar method, by addition only, by means of the ready computed logs. of $\frac{11}{10}$, $\frac{101}{100}$, $\frac{1001}{1000}$, &c. might in some cases be used with advantage; but the method by subtraction, may in general be performed with more facility.

Mr. Manning illustrates his method by computing the hyp. logs. of 2, 1.25, 10, 5548748, and 7; the three former to 10 places of decimals.

Observations.—This paper furnishes an additional specimen of the talents of Mr. Manning; and an additional reason for those who have read the little he has published, to regret that he does not devote more time to mathematical pursuits. The rules prescribed will be found very useful in verifying any part of an adopted table of logarithms; and possess this advantage, that they are completely independent of the other logs. except of such numbers as he has given in his small tables; while the usual methods of verifying tables by interpolation, presuppose the truth of all the other logs. except that which it is proposed to examine; and the method by the several orders of differences is rather of advantage, as it facilitates the computation of an extensive table, than as it applies to the verification of particular parts of a table already in use. Indeed as a method of computing a table of hyp. logs. generally, Mr. Manning's is preferable to most that we have seen; and the mathematical reader who possesses either the history of the constructions of logarithms, given by Dr. Hutton in the introduction to his Tables, or that in the Histoire des Mathematiques of Montucla, will do well to add this to the number of methods described in those interesting performances.

Observations on the Permanency of the Variation of the Compass, at Jamaica. By Mr. James Robertson. *Phil. Trans.* 1806, Part. II.

At the commencement of this communication Mr. Robertson says, it has been hitherto considered that the variation of the magnetic needle is not fixed in any particular place, but is constantly varying in a greater or less degree, in all parts of the world. He has discovered an exception to this supposed general property of variation; and, as it may be, perhaps, the first that has been made, it will require proportionally strong proof to establish it.

The kind of proof adduced by Mr. Robertson is this: In every grant of land, at Jamaica, a plan of the estate with the position of the *magnetic* meridian is attached to the patent. In all disputes at law, about boundary lines, surveyors are appointed to make actual surveys of all the old marked lines on earth and to extract from the secretary of the island's office correct copies of all such

diagrams annexed to patents, deeds of conveyance, &c. of the lands in question, and all that are contiguous. They compare the lines and meridians of these original diagrams with those in their diagrams delineated from their own re-surveys recently made; when it is always expected that the lines and meridians of the former will coincide with those of the latter: a coincidence which could not happen if any variation of the magnetical needle had taken place in the intermediate times between the surveys. Now Mr. Robertson in consequence of extensive business, for 20 years as a king's surveyor of land, has had many opportunities of tracing this exact coincidence between the magnetic meridians on the original diagrams of the year 1660, and others drawn at all intermediate times between that and the present: whence it is inferred that no change of declination can have taken place during all that period of 140 years.

As a collateral proof it is mentioned that according to Mountain's chart, constructed in 1700, from Dr. Halley's Tables, the declination at Port Royal was about $6\frac{1}{2}^{\circ}$ east; and the present declination, ascertained by Mr. Robertson, and laid down in his maps of Jamaica, is $6\frac{1}{2}^{\circ}$ east.

Observations.—We cannot help expressing our surprize that such a letter as this should find its way into the Transactions of the Royal Society. The exception to the supposed general property of the variation, which Mr. Robertson thinks he has discovered, has been known these 50 years. Hallé, on examining the table of declination, published by Van Swinden, deduced some important consequences, among which are his observations relative to the places where the variation of declination was least in the interval between 1700 and 1756. Among these places he first pointed out the whole American or Atlantic Ocean, without including the Gulf of Mexico, that is to say, from the western point of Africa to the farthest of the Bermuda islands; he also remarked that the variation was *much less* towards the American than towards the African coasts. After enumerating many other places, he adds, "In all these different places the declination of the needle had not varied, during the whole 56 years, so much as *one degree*." See *Encyclo. Methodique Médec.* Vol. I. or *Traité de Physique, par Haüy,* Vol. II. Now the Island of Jamaica lies near the space pointed out by Hallé as above, and near enough the American coast to fall in with his general observation; so that all which has been done by Mr. Robertson is to extend the truth of Hallé's observation, at least with regard to one of the American islands, from 56 to 140 years. It is likely enough that an active and intelligent surveyor, so far from the grand field of science as Jamaica, might suppose he had made a new discovery; but we cannot bring ourselves to imagine that none of those who voted for the insertion of this paper in the Transactions knew of

the coincidence of Mr. R.'s observations with those of Hallé as to this particular; or recollected another fact mentioned by Dr. Enfield, namely, that during the same 56 years, the declination at Martinico had been constantly 5 degrees east.

We are aware that it may be said there is not a complete parity between the result of Mr. Robertson's observations and that of Hallé's; the one affirming that there is *no* variation, while the other states merely that it did not amount to *a degree*; but it should be recollected that, while Hallé's remark shews clearly that the variation if any, is very minute, Mr. Robertson's observations are too far from that refinement and accuracy which would be requisite to prove that the needle undergoes neither menstrual nor diurnal variation at Jamaica: the fact is, that, in a general sense, the declination of the needle is nearly permanent in all the tract of surface described by Hallé, and of course it is so at the island just mentioned.

Mr. Robertson is mistaking in thinking the variation of the compass was first observed by Columbus, in 1492. It was noticed by Peter Adsiger in 1269: see the Sup. to Cavallo's Magnetism.

Observations on the Variation and on the Dip of the Magnetic Needle, made at the Apartments of the Royal Society, between the Years 1786 *and* 1805, *inclusive. By Mr.* George Gilpin. *Phil. Trans.* 1806, Part. II.

The variation compass used in Mr. Gilpin's observations is the same as had been used in former observations, published by the Society, and described by the Hon. Henry Cavendish, Esq. in the 66th vol. of the Transactions. To ascertain how far the influence of the iron-work of the building might extend, Mr. Gilpin made observations with the same compass in the wood-yard of Somerset House, at those times of the day when the needle was stationary: by a mean of 200 observations in the yard, compared with twice that number in the house, Mr. Gilpin found the variation in the house to exceed that in the yard by 5′.4: he has, therefore, deducted this quantity from each of his observed variations.

The dipping-needle used by Mr. Gilpin is the same as was used in former observations on the dip, and was likewise described by Mr. Cavendish in the volume above-mentioned. The error in the dip, occasioned by the iron-work of the house, was, by a similar process to the above, found to be 20′, and this quantity is *added* to all the observations made in the house.

The results of Mr. Gilpin's observations are ranged in five tables. The first of these tables occupies 16 pages, and contains results of observations on the declination of the needle, made 12 times each day, from September 1st, 1786, to December 31st, 1787:

they are so disposed that the progress or regress of the variation may be readily seen by mere inspection. From the observations of these 16 months, the variation is considered as generally stationary, at or about seven or eight o'clock in the morning when it is least, and about one or two o'clock in the afternoon, when it is greatest.

The second table contains the mean monthly variation for all the times of the day contained in table 1.

The third table contains, besides the mean monthly true variation, and mean monthly diurnal alteration of variation for the above-mentioned months, the mean monthly true variation, and diurnal alteration of variation for many months in the year, between the years 1786 and 1805 inclusive.

The deductions from this table are of two kinds: 1st with regard to diurnal alteration of variation. In March 1787, this was found to be 15′. 0; in June, 19′.6; in July 19′. 6; in September 14′. 8; and in December, 7′. 6. But on a mean of 12 years observations, from 1793 to 1805, the diurnal alteration of variation in March was only 8′. 5; in June 11′. 2; in July 10′. 6; in September 8′. 7; and in December, 3′. 7. The diurnal alteration in summer may be reckoned on an average full double that in the winter.

The 2d inference regards the annual increase of variation. Now the variation itself, taken in the month of July from 1790 downward, is as below:

1790 . . .	23° 39′. 0;	1798 . . .	24° 0′. 0;
1791 . . .	23° 36′. 7;	1799 . . .	24° 1′. 8;
1792		1800 . . .	24° 3′. 0;
1793 . . .	23° 50′. 5;	1801 . . .	24° 4′. 1;
1794 . . .	23° 54′. 4;	1802 . . .	24° 6′. 0;
1795 . . .	23° 57′. 1;	1803 . . .	24° 7′. 9;
1796 . . .	23° 59′. 2;	1804 . . .	24° 8′. 4;
1797 . . .	24° 0′. 3;	1805 . . .	24° 7′. 8.

From the observations made by the late Dr. Heberden and others, about the year 1775, the variation was found to increase annually nearly 10′.; since that time to the present its rate of increase has been considered as gradually diminishing; and for the last three or four years, the alteration has been so very small as to render it doubtful whether it may not be considered stationary.

The fourth table contains the differences for 12 years, viz. from 1793 to 1805, between the observations of the variation made in the months of March, June, September, and December, or at the times of the equinoxes and solstices. By a mean of these 12 years the variation appears to increase or go westward, from the winter solstice to the vernal equinox, 0′.80; to diminish or go eastward from the vernal equinox to the summer solstice, 1′.43; to increase again from the summer solstice to the autumnal equinox, 2′.43; and to decrease only 0′.14 from thence to the winter solstice.

The fifth table contains the dip of the magnetic needle from 1786 to 1805. For the first 16 months the dip was observed as often as the variation, but *there did not appear to be any diurnal alteration in the dip.* Mr. Whiston, whose needle there is reason to believe was more to be relied upon than Norman's or Bond's, determined the dip in 1720, to be 75° 10′ ; this, compared with Mr. Cavendish's accurate observations in 1775, when he found the dip to be 72° 30′ makes the decrease in this period of 55 years, on a mean 2′.9 per annum. And from a comparison of Mr. Gilpin's observations of the dip in August 1805, when he found it 70° 20′, with those of Mr. Cavendish in 1775, its annual decrease, on a mean, appears to have been 4′.3 ; and its progressive annual decrease, on a mean in the abovementioned period of 30 years, to have been 1′.4.

Observations.—We were much gratified to find once more in the Philosophical Transactions an account of the variation and dip of the magnetic needle, as observed at Somerset-house ; and we must be permitted to express a hope that in future the observations will be regularly continued, and as regularly inserted in the annual volumes of the Transactions. Such a procedure, if uniformly pursued, might ere long lead to the adoption of similar observations by the societies and academies at Edinburgh, Dublin, Paris, and other parts of Europe ; and this would furnish rational ground to expect in due time a more plausible theory of the mutations of the needle than any which has yet been advanced.

That our readers may be enabled to form some judgment of the coincidence or difference of Mr. Gilpin's and other observations, we shall, as far as our limits will allow, state a few particulars in this place. And first we may remark the general agreement of Mr. Gilpin's observations on the diurnal variation with those of Mr. Canton, who found that the diurnal variation in June and July was almost double of that in December and January, increasing from January to June, and decreasing from June or July to December, and that the absolute declination of the needle westward was increasing from about 8 or 9 in the morning, till about 1 or 2 in the afternoon, when the needle became stationary for some time, after which, the absolute declination westward was decreasing, and the needle came back again to its former situation or nearly so, by the next morning. See Phil. Trans. vols. 48 and 51.

With regard to the annual increase of declination, Mr. Gilpin's observations strongly indicate that it is approaching a limit ; and, in like manner, some observations at Paris favour a similar conclusion : for, in that city, from 1792 to 1794, the declination appeared fixed at 21° 54′, W. ; in 1798 it was 22° 15′ ; in 1799, 22° 0′ ; in 1800, 22° 12′ ; in 1801, 22° 1′ ; in 1802, 21° 45′ ; in 1803, 21° 59′ ; in 1804, 22° 15′, being for a period of 12 years, sometimes stationary, at others retrograde, as if oscillating about

a limit. Thus also, its movements have been nearly the same at Geneva, where in 1800 the declination was 21° 29′, and in 1804, 21° 13′. So again, many naval officers are of opinion that in the western parts of the English channel, the declination has never reached 25°, and has already begun to decrease. While, on the contrary, Mr. Harding asserts that, at Dublin, the change in declination has been uniformly about 12′ 20″ annually from 1657, when there was no declination either at London or Dublin till May 1791, when it was 27° 23′ W. What the declination is now at Dublin we know not; though it is a datum we should be very glad to possess, that we might see how far it also indicated an approach to a limit westward.

We add here, as it may gratify some of our readers, that M. Burckardt, one of the most able French astronomers, invented a formula to represent the magnetic declinations observed at Paris; thus, if t denote the number of years from 1663, the tangent of the declination is 0.449 sin. (25′ 7″) t + 0.0425 [sin. (50′ 13″) t]^2 + 0.0267 [sin. (1° 40′ 26″) t]^4. It follows from this formula that the eastern declination diminished from 1448, when it was at its maximum of 24° 10′, to 1663, when it was nothing at Paris. Reckoning an equal period backward from 1488 gave 1233 for the earlier epoch when there was no declination. A little before this the invention of the mariner's compass is generally dated: a time when the declination was probably too small to be discovered by the instruments then in use. According to Burckardt's theorem the maximum of western declination at Paris will be in the year 1831; though it will not vary more than 20 minutes from that time to 1878. We mention these as curious results of this astronomer's investigation; but would by no means be understood as affirming their accuracy.

We shall conclude with objecting to the term *variation* of the magnetic needle, used by both Mr. Robertson and Mr. Gilpin; we know it is authorized by long usage, but it is not a whit the more defensible on that account. The term is extremely ambiguous, and in many instances leads to the disgustingly pleonastic phrase of "variation of the variation." The precision of ideas which philosophers wish to attain and to communicate, is best promoted by perspicuity of language; and the greatest obstacles to philosophical improvement, next to terms of no meaning, are phrases of double meaning. We would recommend, therefore, that in future, writers on these subjects use the term *declination* to denote the distance of the magnetic from the true meridian in degrees measured upon the horizon, and *inclination* to represent the angle which the dipping needle makes with the horizon as measured on a vertical or azimuth circle; the changes in the declination and inclination may be represented by the words variation and alteration respectively; and thus would all ambiguity be completely avoided.

On the Declinations of some of the principal fixed Stars; with a Description of an Astronomical Circle, and some Remarks on the Construction of Circular Instruments. By JOHN POND, *Esq.*—*Phil. Trans.* 1806. Part II.

THIS paper will be interesting to practical astronomers, and will furnish them with some important topics of reflection; but it is not susceptible of a satisfactory abridgment in moderate limits. It contains, however, a statement of one circumstance, which, if found true, ought not to be passed over in silence. This relates to the celebrated mural quadrant in the Greenwich Observatory, which, as Mr. Pond remarks, is so intimately connected with the history of astronomy; the observations that have been made with it, and the deductions from these observations, are of such infinite importance to the science, that every circumstance relating to it cannot fail to be interesting. Now, Mr. Pond suspects that on account of constant use for half a century, the center error has a regular tendency to increase, and that the former accuracy of the instrument is somewhat impaired. Indeed he affirms that from some observations of the sun at the winter solstice in 1800, the difference between the Greenwich quadrant and the circular instrument was found to be 10″ or 12″, the quadrant giving the zenith distance too little. We trust this circumstance will attract the notice of our excellent Astronomer Royal; whose care, vigilance, and skill, will, we doubt not, soon ascertain how far there is any room for Mr. Pond's suspicion.

Observations and Remarks on the Figure, the Climate, and the Atmosphere of Saturn, and its Ring. By WILLIAM HERSCHEL, L.L.D. F.R.S. *Phil. Trans.* 1806. Part. II.

THE principal objects of Dr. Herschel in these observations and remarks seem to be to confirm and establish his account of the figure of Saturn, given in the Philosophical Transactions for 1795, and to shew that the objections which have been advanced against his former statement are of little or no weight.

Thus, the Doctor says, those who compare the figures of Saturn exhibited in the Phil. Trans. for 1790 and 1792, (the former with a view of shewing the proportion of the equatorial and polar diameters of the planet, the latter to shew the configuration of the changeable belts), and others he has occasionally given, in which the shape of the planet was not intended to be represented; with

the diagram contained in his last paper, of which the sole purpose was to express that figure, and wonder at the great difference, have probably not read the measures he has given of the equatorial and and polar diameter of this planet. He, therefore, remarks that the proportion of the diameters, 22.81, to 20.61, is the same, or nearly the same, as determined in 1789 and 1805; and that the sole difference of the figures arises from the flattening near the poles, and the greater curvature in the middle latitudes, which had been overlooked in 1789, when his attention was entirely taken up with an examination of the principal diameters.

Again, the Doctor remarks, the use of various magnifying powers in observing minute objects is not generally understood. A low power, such as 200 or 160, with which he has seen the figure of Saturn, is not sufficient to shew it to one who has not already seen it perfectly well with an adequate high power; an observer, therefore, who has not an instrument that will bear a very distinct magnifying power of 500, ought not to expect to see the outlines of Saturn so sharp, and well defined, as to have a right conception of its figure. The quintuple belt is generally a very good criterion; for if that cannot be seen the telescope is not sufficient for the purpose; but when we have entirely convinced ourselves of the reality of the phenomena thus pointed out, we may then gradually lower the power, in order to be assured that the great curvature of the eye-glasses giving these high powers has not occasioned any deceptions in the figure to be investigated.

Farther, when it is known that Dr. Herschel's last year's most decisive observation, relating to the singular figure of Saturn, was made the 5th of May, astronomers may then calculate by this date the places of Saturn and the Earth; their distances from each other, and the angle of illumination of the Saturnian disc: by this means may be found the gibbosity of the planet in the given situation, and that the defalcation of light could not then amount to the one hundredth-part of a second of a degree, and that consequently no error could arise from that cause.

Having said thus much in order to remove the objections to his former paper, Dr. Herschel proceeds to relate some farther observations in chronological order. It is unnecessary to detail all these, but two or three of the most prominent may be selected. Thus,

1806. "May 5th—10 feet, power 527.—The air is very favourable, and I see the planet well with this power.—The diameter which intersects the equator in an angle of about 40° or 45°, is apparently a little longer than the equatorial, and the curvature is greatest in that latitude. The planet being in the meridian, and the night beautiful, I have had a complete view of its figure. It has undergone no change since last year, except what arises from its different situation, and a greater opening of the ring."

"May 15th.—The following particulars remain as my last year's observations have established them. The flattening at the

poles of Saturn is more extensive than it is on the planet Jupiter. The curvature in high latitudes is also greater than on that planet. At the equator, on the contrary, the curvature is rather less than it is on Jupiter Upon the whole, therefore, the shape of the globe of Saturn is not such as a rotatory motion alone could have given it. I see the quintuple belt, the division of the ring, a very narrow shadow of the ring across the body, and another broader shadow of the body upon the following part of the ring ; and unless all these particulars are very distinctly visible, we cannot expect that our instrument should shew the outlines of the planet sufficiently well to perceive its peculiar formation."

" June 9th.—I viewed Jupiter, and compared its figure with that of Saturn. An evident difference in the formation of the two planets is visible. To distinguish the figure of Jupiter properly, it may be called an ellipsoid, and that of Saturn a spheroid.

The Doctor then proceeds to relate his observations on the periodical changes of the colour of the polar regions of Saturn, which he supposes to arise from a periodical alteration of temperature ; and on the brightness which remains on the north polar regions, which is not uniform, but tinged here and there with large dusky looking spaces of a cloudy appearance ; from the whole he infers the existence of a Saturnian atmosphere ; as we certainly cannot ascribe such frequent changes to alterations of the surface of the planet itself ; and if we add to this consideration, the changes Dr. H. has observed in the appearance of the belts, or even the belts themselves, we can hardly require a greater confirmation of the existence of such an atmosphere.

Observations.—We think Dr. Herschel has now been in great measure successful in overturning the objections to which we adverted, when we spoke of his former paper in our fourth number, and we doubt not that his additional observations will be gladly received by astronomers. But he has not been so successful in conveying a distinct idea of the difference in shape between Saturn and Jupiter as he seems to suppose ; at least we can attain no such idea independent of his diagrams. The Doctor proposes to distinguish the form of these two planets properly, by calling that of Jupiter an *ellipsoid*, and that of Saturn a *spheroid*. Now, what is the essential difference between the meanings of these two terms ? Most mathematical writers use them indifferently, to denote a solid generated by the rotation of an ellipse upon either its major or its minor axis. Some few, however, confine the term ellipsoid to the solid, generated by the rotation of an ellipse, while they apply the term spheroid to the solid formed by the rotation of any *oval* upon one of its axes : yet the admission of this distinction between the terms will not add any thing to the precision of Dr. Herschel's language ; for how do the ellipse and the oval, from which the planets are supposed generated, differ from one another ?

Unless this be stated, we get nothing but words in current payment, to which no meaning appropriate to the point in hand is attached. Other mathematicians again sometimes call the solid, which deviates least from a sphere, a spheroid, and that which is generated from an ellipse, whose difference of axes is comparatively considerable, an ellipsoid: but even this distinction will not avail in the present case, because the figure of Jupiter deviates less from a sphere than that of Saturn. We are sorry that a philosopher of Dr. Herschel's well earned reputation should run into a vague use of mathematical terms: we admire his indefatigable application as an astronomical observer; but we think he would be more likely to preserve the lustre of his reputation unimpaired, if he took a little more pains in preparing for publication the results of his labours.

New Theory of the Aurora Borealis. By M. Libes. *Nouv. Dict. de Phys. tom.* 1.

The philosophers of the north, better situated than we are to observe this phenomenon, and to appreciate its cause, have already adopted this theory: we therefore conceive it will be interesting to the English reader. M. Libes has founded it upon the following principles:

1. If we excite the electric spark in a mixture of azotic and oxygen gas, there will result nitric acid, nitrous acid, or nitrous gas, according to the relation that subsists between the gases which compose the mixture.

2. Nitric acid, when exposed to the sun, assumes more colour and volatility. Scheele first observed this phenomenon. Libes placed a receiver over a salver containing nitric acid and exposed to the action of the solar rays. Some minutes after, the acid appeared coloured, and the receiver filled with red and volatile vapours, which were sustained in it a long while, and diffused a light similar to that of the aurora borealis.

3. In flasks which contain nitrous acid, a ruddy and volatile vapour is always perceived above the vapour.

4. Nitrous gas, in contact with atmospheric air, exhales ruddy vapours, which fly off into the atmosphere.

5. The hydrogen, which is disengaged from the surface of the globe, rises till it occupies in the higher regions of the atmosphere a place determined by its specific gravity.

6. The solar heat has very little activity in the polar regions.

These several principles rest upon observations and experiments made with the greatest exactness, and most of them too well known to need being described here. Now it is manifest from a simple combination of these facts: 1st. That the production of hydrogen must be almost nothing in the polar regions: 2dly. That the

higher regions of the polar atmosphere contain very little if any hydrogen: 3dly. That whenever there is a re-establishment of equilibrium of the electric fluid in the polar atmosphere, this fluid can only find in its passage a mixture of azote and oxygen: 4thly. That the electric spark ought to fix and combine these gaseous substances: 5thly That from this combination must result a production of nitrous acid, of nitric acid, or of nitrous gas, according to the relation subsisting between the oxygen and azote that constitute the mixture: 6thly. That the production of either of these acids, or of the gas, will give birth to red and volatile vapours, whose elevation in the atmosphere will form the meteor known under the name of the aurora borealis.

After removing some general objections to these preliminary notions, M. Libes applies them to the phenomena, as below:

1st *Phenomenon.* The auroræ boreales are sometimes accompanied by slight detonations.

In the polar regions, the production of hydrogen is next to nothing, by reason of the little activity of the solar heat. It is nevertheless true, that in summer the long duration of the sun above the horizon causes even there a heat sufficiently considerable to produce the disengagement of some small portion of hydrogen, which will rise up to the higher regions of the atmosphere: whence it results, that if the re-establishment of equilibrium of the electric fluid takes place in the polar atmosphere, when its superior strata contain this gaseous substance, the electric spark must exert upon it a part of its activity, and produce slight detonations.

2d *Phenomenon.* The major part of auroræ boreales appear to move from the north towards the south; though some are seen whose motion is directed towards the east or west.

The nitric acid, nitrous acid, and nitrous gas, which give birth to auroræ boreales, have their origin towards the poles. These substances exhale ruddy vapours, which, as they rise in the atmosphere, must direct their motion towards the place where they meet with least resistance; which is, of course, towards the south, where the air, always less dense than about the north, offers them a more free and easy passage. It may also happen that at the same time, these ruddy vapours are formed, a northerly wind may blow in the upper region of the atmosphere, and thus give them a strong impulsion which, combined with the preceding general tendency southward, may cause the resulting motion to be sometimes southward, at others eastward, or westward.

3d *Phenomenon.* The auroræ boreales sometimes exhibit themselves under the form of luminous columns having different figures and different directions. Some are cylindrical, others pyramidal, others are curved in the shape of an arc. When they are impelled with much activity, they proceed to the zenith of the spectator. Those whose motion is still more rapid, go on beyond the zenith, sometimes even till they reach the southern horizon. They do not al-

ways rise directly from the centre of the cloudy part towards the zenith ; but sometimes take a lateral direction, especially when the cloud from whence they spring is found suspended between the north and the east or west.

When the re-establishment of equilibrium of the electric fluid fixes and combines a great quantity of azote and oxygen, the ruddy vapours resulting from this combination must occupy a large space in the atmosphere. These vapours being of such considerable extent, and impelled from north to south, must sometimes separate from one another, the different portions receiving various directions; thus they will be carried sometimes perpendicularly, at others parallel to the horizon ; at others parallel to the earth's axis ; whence it follows that the aurora borealis must sometimes appear to the observer in the form of columns, whose number, figure, and direction are determined by circumstances. It may also sometimes happen that these luminous columns remain for a time immoveable, with respect to the horizon. This ought to be the case whenever a wind impels the luminous cloud towards any part whatever from the south, with the same force as the exhalations are impelled towards it by a contrary wind.

4th *Phenomenon.* The auroræ boreales do not all shine with an equally vivid lustre; some have a mild and tranquil light, others shine with a very resplendent brilliancy.

The vapours which are disengaged from nitric acid exposed to the solar rays, diffuse a mild light of a clear red verging toward yellow ; those which are perceived above them, from nitrous acid are of a deep red ; those exhaled from the nitrous gas, in contact with the atmospheric air, are at first of a pretty deep red, which afterwards become more and more clear and light, as those vapours extend themselves more in the atmosphere. The luminous columns, therefore, presented by the aurora borealis, have different colours, according as the ruddy vapours take their rise from the formation of the nitric acid, of the nitrous acid, or of the nitrous gas.

Observations.—From this sketch of M. Libes's theory, it appears that in his opinion electrical light is not the cause of the aurora borealis ; and that electricity itself has no farther influence upon their existence than as it fixes the aeriform substances whose combination occasions the meteor. This philosopher's theory applies manifestly in like manner to the auroræ australes. The chief difficulty in our opinion consists in explaining the cause of the luminous columns, mentioned under the fourth head ; and here we conceive M. Libes is by no means so successful as might be wished. In this respect we should prefer the theory of Mr. Dalton, published in his *Meteorological Essays ;* a theory which has not, we think, met with half the attention its ingenuity entitles it to.

New Explication of the Phenomena of Elasticity. *By* M. Libes. *Nouv. Dict. de Phys.* tom. I.

This explication is founded upon the three following principles:

1. The signs of elasticity suppose a compression effected, that is, an alteration in the figure of bodies produced by the mutual approach of the moleculæ: whence it results, that bodies, whose moleculæ yield with a very great facility to the slightest pressure, so as to roll one over another without changing their figure, cannot give sensible signs of elasticity. Such in general are liquids.

2. When an elastic body is compressed, some of its integrant moleculæ are brought nearer to one another, while others undergo a farther separation nearly equal to the approach of the former.

3. At the habitual degree of heat and pressure which we experience, all bodies have a volume determined by the ratio of equality, which exists between the attractive force of their particles, and the repulsive force communicated by the caloric combined with those particles.

These being granted, the re-establishment of solid bodies, after the compression, appears to be the result of the combined action of the caloric and of attraction. For in the moleculæ brought nearer by the compression, the repulsive force augments, and the attractive force likewise augments; but the augmentation of the former force exceeds that of the latter. For, at the epoch of the formation of the body, such as it existed previous to the compression, the repulsive force communicated to its moleculæ by the caloric, was sufficient to give the degree of separation that was peculiar to the body: it was, therefore, superior to the attractive force until the moment when the moleculæ had become so far separated as was consistent with the natural state of the body. Whence it results, that if the particles are brought nearer together by compresssion, that is, if they are contracted with the caloric into a smaller space, the ratio of equality which subsisted between the attraction and the repulsion before the compression, must be destroyed in favour of the repulsion; and consequently, on the cessation of the compression, this surplus of repulsive force will act so as to separate again the moleculæ brought nearer by the compression until the equilibrium is re-established between the attraction and the repulsion: and this equilibrium can only be re-established, when the moleculæ have recovered the degree of separation, which they had previous to the compression.

For similar reasons the attraction will predominate over the repulsion in those particles which have suffered a farther separation than is due to the natural state: it must, therefore, act to draw the particles nearer, and re-establish the equilibrium of those forces: and this equilibrium cannot be re-established until the

moleculæ have recovered the relative distance which they had before the compression.

This theory, M. Libes applies to an elastic sphere, as an ivory ball when falling upon a plane, to a plate of steel, whose extremities are brought towards each other by bending, and to the known effects of tempered metals, &c.

In explaining the elasticity of aeriform fluids, M. Libes calls into his aid a new force. For, in this kind of substances, the repulsion having prevailed over the attraction, their particles are retained in their mutual position by the pressure of the atmosphere. But this force, it may be observed, being constant, makes no change in the results just stated: except that if the pressure be taken away, the particles of the gas will be separated from one another, until their relative distance attains a point determined by the equality between the attraction of the earth, and the repulsion of those particles.

Now since all bodies contain caloric, it may be asked how it happens that all bodies are not elastic, if caloric be the principle of elasticity? To this M. Libes replies by the following remarks.

1st. Since there is not in nature any body, either perfectly hard, or perfectly soft, there is none but what possesses some degree of elasticity.

2dly. Perceptible signs of elasticity suppose the compression effected: it is not therefore surprising, that bodies in which we cannot produce compression, should not give any sign of elasticity.

3dly. Although caloric be the principle of elasticity, it does not follow that all bodies which contain caloric, must exhibit this property. 1 Too much or too little caloric may equally weaken the elastic force. The different forms which distinguish the integrant moleculæ of different bodies, the different arrangement assumed by those moleculæ, according to circumstances, may be sometimes more or less favourable, at others more or less prejudicial to elasticity. 3. Soft bodies, such as butter, humid clay, &c. experience in their soft state, a commencement of solution by water, which must alter the repulsive force of their moleculæ, and consequently hurt the elasticity. This is so true, that these bodies, freed from their aqueous part, without changing their temperature yield sensible signs of elasticity.

M. Libes instead of attempting to explain, as some would expect, why caloric is elastic, says it is not necessary to suppose it so. For it may communicate this property to other bodies without being so itself. This position he illustrates as follows: when dry bread is immersed in water, that bread becomes swoln, its particles being farther separated from one another: water, therefore, by penetrating the pores of the bread, communicates to its particles a repulsive force; yet it would be ridiculous to conclude from hence, that the moleculæ of water mutually repel one

another. In like manner, when we subject a body to the action of heat, its integrant moleculæ are separated from one another, and acquire a repulsive force by their combination with caloric: but this phenomenon, like the preceding, probably depends upon the concourse of several attractive forces, such as that of the moleculæ of the caloric, that of the particles of the body for one another, and lastly the reciprocal attraction of the particles of the caloric and those of the body penetrated by that fluid; whence it results that the elasticity of bodies by no means presupposes that of the caloric which has given rise to it.

Indeed, M. Libes does not regard as completely demonstrated the existence of the fluid called caloric, he assumes the hypothesis as a matter of convenience, which enables us to abridge the language of philosophical discussions, and to found upon our reasonings an analytical calculus. He next, therefore, proceeds to state his theory analytically; and deduces from his formulæ the following results among others. 1. That when we compress elastic fluids, the repulsive force becomes more powerful than the attractive, and consequently when the compression ceases, the moleculæ ought to return towards their first position. 2. That liquids and aeriform fluids have the exclusive privilege of assuming a larger volume when the pressure of the atmosphere is taken away.

On the Inefficacy of bending Axles forward as a Remedy for the destructive Effects of conical Carriage Wheels, together with Observations on a practical or second Sort of Conical Friction, &c. By an ENGINEER.—*Rep. of Arts,* No. 56, New Series.

WIDE rimmed carriage wheels having their surfaces in the form of frustums of cones, are productive of many disadvantages, both as they effect the wearing of the roads, and as their additional friction increases the labour of the horses. Alexander Cummings, Esq. in a communication to the Board of Agriculture (published likewise in the 13th volume of the *Repertory of Arts*), has shewn the nature and effects of that kind of friction which arises from conical wheels being compelled to accommodate their motion to that of the axle in a direction parallel to itself, instead of turning in the circumferences of large horizontal circles, as they would do if not prevented by their connection with the axle. But some wheelwrights and others suppose that they alleviate, if not entirely remove, the evils Mr. Cummings points out, by bending the axles forward. The purpose of the present communication, therefore, is to shew the inefficacy of this pretended alleviation.

The author observes at the outset of his paper that there exists a new or second description of conical friction, which affects narrow

rimmed conical wheels more than wide ones, while in its effects it neither increases nor decreases the operation of the first kind of conical friction described by Mr. Cummings. Although he only endeavours to explain this effect with imaginary narrow rimmed conical wheels; yet it will be easy to conceive the effect on wide rims, by supposing such to be composed of so many narrow rims put together, each of which being allowed to support only its portion of a given weight, the narrow rimmed wheel supporting the whole of a like given weight, will create as much of this friction as the wide rimmed wheel, both being supposed sunk an equal depth; and that, inasmuch as the narrow wheel sinks deeper than the wide one it will create a greater degree of the said friction.

For the sake of abbreviating language, and giving more perspicuity to his remarks, this author supposes a circular section of the wheel to be constituted of a number of segments: and he uniformly considers that three such segments of the rim of each wheel bear on the ground at the same time; these he distinguishes thus: that which is perpendicularly under the axle of the wheel, he calls the *bottom segment,* the other two *ascending* and *descending* segments; the portion next to the bottom towards the part of space the wheel is leaving being the *ascending segment,* and the portion next the bottom towards the part of space the wheel is moving into, the *descending* segment. He then supposes the earth to be so elastic and yielding as to form such concaves as will permit the bottom segment of each wheel to be six inches below the common surface, and these wheels, being conical, to turn upon an axle whose ends are inclined downwards about 10 degrees; when a much greater resistance will be experienced than if the wheels were cylindrical and placed vertically: in examining the cause of this he considers that, if the bottom segments are but five feet asunder, the descending segments are 5 feet 2 inches, and the ascending ones the same; so that it is evident that as the centres and upper parts of the wheels advance, to cause the descending segments to become bottom ones, such will necessarily be drawn *two inches* nearer together, while the bottom ones in becoming ascending segments are driven *two inches* farther apart; and as neither of them have been removed from the ground into which they had sunk, they must have rubbed with considerable friction. This our author calls practical conical friction; and it is manifest it will be greater when the wheel sinks more than six inches below the common surface than it is represented above.

The wheelright's scheme of bending the axles forward is next considered; and that it may have a fair trial, it is supposed that the axles are bent forward till the descending segments of the pair of wheels are perceived to be brought as near together as the bottom ones. If the effect is then examined it will be found that the descending segments are really exempted by this contrivance

from the second kind of conical friction, and so far the wheeler is right. But unfortunately for his plan, it appears that the bottom segments in ascending are now driven off two inches instead of one, so that we are no better off with the wheelwright's assistance than without it. To illustrate his views of the inconveniencies attending this construction, our author says, without altering either the axles or the wheels, suppose we proceed with the cart to a neighbouring pasture, and see the effect of the bent-forward axle there. To our great mortification we shall find that a moderate team of horses, together with the velocity the cart acquires previous to its entering the fields, will only enable us to get a few yards on the pasture, when we shall have cause to adopt the carter's language, " we're all stuck fast" : for here we shall discover that the descending segments of the wheels have been cutting *two deep ruts*, while the ascending ones have been ploughing two equally deep *furrows*. If the axles had not been bent forward, no furrows would have been ploughed, because, though these wheels are conical, and run on bent-down axles, they would have received no more impediment from the sides of their own cut ruts, than vertical wheels would receive from theirs ; since it is obvious that vertical wheels will cut vertical ruts, whose sides will be parallel to the sides of such wheels, while it is equally obvious that conical or inclining wheels will cut ruts equally inclining, and of course equally parallel to the sides of their rims : so that in as much as the bending of axles forward is useless in good roads, we see it injurious in bad ones.

From the whole, this author concludes that it must be highly necessary to adopt some better means to prevent the enormous extra wear and tear of roads, wheels, and horses, occasioned by the ground friction of conical carriage wheels, with either wide or narrow rims. And he is strongly of opinion that nothing but cylindrical and straight axles, generally adopted, can accomplish this desirable purpose.

Observations.—The writer of this paper has certainly considered his subject with much attention ; and the results of his enquiries deserve the notice of the public. The exposure of the inutility of bending the axles *forward*, will we hope be duly regarded. We are surprised that so prejudicial an expedient should have been often adopted, even so long back as the time of Beighton, who was its warm partisan ; and never have met with a complete detection till now. Indeed, let conical wheels be attached to their axles in what manner they may, still the grand evil remains : for when a cone is put in motion upon a plane surface, it will revolve about its vertex as a centre ; and if any extraneous force be employed to confine it to move in a right line, the smaller parts must be dragged along : thus, when conical wheels are constrained to

move in a straight path, there is a constant rubbing and indenting of the surface they pass over, whence arise the kinds of friction treated above by our author; and besides these, each cone having a constant tendency to turn about its vertex, this, together with ground friction, causes a very irregular pressure upon the axle, and a constant unequal wearing away of its different parts, as well as considerable friction against the linch-pin and the shoulder of the axle-tree.

The same author proposes offering his opinion, on the comparative advantages of wide and narrow cylindrical wheels, and of great and small diameters: if we may judge from the preceding specimen, his lucubrations cannot fail to be beneficial.

On Canal Track Boats. By Robertson Buchanan, *Esq.* *Phil. Mag.* No. 103.

The canal boats briefly described by Mr. Buchanan, are used upon the Grand Canal which joins the Liffy with the Shannon. The general form and appearance of these vessels are much like those on other canals; but they are distinguished from others by their conveniences for passengers, and a few interesting particulars.

1. There is a large board at the head of each vessel, which is occasionally raised up, to prevent the water issuing from the sluices from filling the boat; an accident which has sometimes caused the sinking of a boat, and the loss of many lives.

2. There are pieces of plate-iron at the stern, which are let down, when necessary, to retard the motion of the vessel: an expedient often useful in entering locks.

3. The smoke-pipe from the cooking-house, and that from the cabin stove, are contrived to prevent the disagreeable effects of eddy winds. This may be best explained, independent of a plate, by assuming some numeral dimensions. Let the cylindrical smoke-pipe be 6 inches in diameter; then upon this is fastened a hollow conic frustum of about 18 inches in height, its upper diameter being 6 inches, and its lower diameter 15 or 18 inches; a circular orifice in the middle of this base of the frustum, of 6 inches diameter, is fitted upon the top of the cylinder, the other part of the same base projecting horizontally all around: from the top of the conic frustum there proceed four bent iron bars, slender, but sufficiently strong to support at the distance of 5 or 6 inches still higher, a conical hollow cap, of about 7 inches diameter at bottom, and 8 or 9 inches in altitude; its apex terminating towards the zenith, and the respective parts of its curve surface parallel to those of the curve surface of the frustum.

The smoke issues from the space between the conic frustum and the complete cone; and when, in consequence of eddies, the smoke is driven downwards towards the cylindrical pipe, it is naturally impelled along the curve surface of the conic frustum till it reaches the projecting parts of its base, from whence it is carried up again, by the lateral communication of motion, with the smoke that arises from the pipe.

4 The manner in which the track-rope is attached to the vessels, is well calculated to prevent accidents, as it enables any person aboard to disengage the loop of the rope in a moment. This loop hangs over a vertical pin which is firmly connected with a frame that is bolted to the deck above the cabin: a lever placed nearly horizontally has a hole at one end large enough for the pin carrying the loop to slide freely through it as the lever turns on its fulcrum, while an appropriate notch at the end of the lever keeps the loop from being lifted off the pin by means of any sudden jerk, or elevation in the rope: this end of the lever naturally preponderates, and allows the loop to remain on the pin while the horses pull properly forward; but should any accident occur and endanger their being dragged into the water, all that is necessary is for a person to put his foot on the contrary end of the lever in order to depress it, and cause the other end to rise, and to raise with it the loop of the track-rope, that it may be disengaged the moment it reaches the top of the pin. A similar contrivance is placed at the top on each side of the cabin.

Remarks.—The simple contrivances mentioned in this letter are each calculated to be useful. Those especially which, in our account, are numbered 3 and 4, are the result of much ingenuity. The 3d may easily, and we believe *successfully* in many instances, be applied as a remedy for chimnies which, on every change of the wind, throw the smoke into the room: and the 4th has, with a slight modification, been applied to free carriages from restive horses in time of danger, for which a Mr. Williams obtained a patentin 1802, as may be seen in Repertory of Arts, Vol. I. Second Series.

Description of a very simple and useful Scale, for dividing the Vanishing Lines in Perspective. By G. CUMBERLAND, *Esq. Phil. Jour.* No. 65.

IN Mr. Cumberland's opinion the art of perspective may be very easily acquired: for he who can put horizontal and vertical lines into perspective, will soon be able to accomplish every thing

else that is required. This gentleman's simple contrivance, for vanishing lines, is as follows:—Take a piece of paper of an octavo size, and rule upon it with very black ink a right line parallel to one of the longer sides of the paper: this line represents the *horizontal line.* At its centre fix a point, which may be called the *moveable point of sight:* afterwards cross it with as many diagonal lines as you please. Thus you have an instrument prepared that will be a sure guide to an inexperienced eye, in taking the perspective lines of all objects placed at right angles; such as streets, buildings, apartments, &c. by merely placing it under the leaf you mean to draw them on from nature, so that the lines may be seen faintly through, as inexperienced boys use their writing copies.

Mr. Cumberland also recommends a corresponding plate of glass having lines similarly posited, which may occasionally be held up vertically; and another sheet for vertical lines. He adds, that the scale should be longer than the drawing-book each way; by which means the artist can, by barely sliding it to the right or left, at pleasure place the point of sight, more or less to the right, or left, or middle of the horizon: and to be provided for all circumstances, it would be as well to be provided also with a scale with a high horizon, and another with a very low one, such as the Dutch painters generally used, and which always produces a picturesque effect, by giving many profiles of the elevation and multiplying the lines of sight.

Observations.—These easy expedients, together with practice, will, in Mr. Cumberland's views, soon complete the artist. On the contrary, we are disposed to think, that, although a person may by these helps be enabled to sketch a stiff and formal outline of the objects before him, it will never give him the ease and freedom of an artist. A lame man may, with the assistance of crutches, walk from one place to another; but it is impossible he should display that gracefulness and agility in his motions which are exhibited by others. No judicious teacher of the harpsichord would permit his pupil to paste the names of the notes upon the several keys: and the contrivances here recommended by Mr. Cumberland ought, in our opinion, to be rejected for a similar reason; they would give a little facility at the outset of a person's application, which might be more than counterbalanced by *fettering* the hand, if we may so say, and preventing it from acquiring that liberty of execution which constitutes an essential qualification in an artist who is master of his profession.

The Invisible Lady; being an Explanation of the Manner in which the Experiment in London, by M. Charles, and others, is performed. In a Letter from a Correspondent. Phil. Jour. No. 65.

Letter from a Correspondent on the Exhibition of the Invisible Girl.—Phil. Jour. No. 66.

The author of the first of these communications, having observed that the secret of the invisible girl has not yet been published, here presents the explanation of it given by Mr. Millington of Chancery-lane, in his Philosophical Experiments.

The visible part of the apparatus connected with the invisible girl is this:—First, a mahogany frame not very unlike a bedstead, having at the corners four upright posts, about five feet high, which are united by a cross rail near the top, and two or more cross rails near the bottom, to strengthen the frame: these cross rails are about four feet in length. The frame thus constructed stands upon the floor, and from the top of each of the four pillars springs one of four strong bent brass wires, converging towards the top, where they are secured by a crown and other ornaments. From these four wires a hollow copper ball, of a foot in diameter, is suspended by slight ribbons so as to cut off all possible communication with the frame. This globe is supposed to contain the invisible being, as the voice apparently proceeds from the interior of it: and for this purpose it is equipped with four trumpets, placed round it in a horizontal direction, and at right-angles to each other, the trumpet mouths coming to within about half an inch of the respective cross rails of the frame surrounding them.

When a question is proposed, it is asked from any side of the frame, and spoken into one of the trumpets, and an answer immediately proceeds from all the trumpets, so loud as to be distinctly heard by an ear addressed to any of them, and yet so distant and feeble that it appears as if coming from a very diminutive being. In this the whole of the experiment consists, and the variations are, that the answer may be returned in several languages, a kiss will be returned, the breath producing the voice may be felt, and songs are sung, accompanied by the pianoforte, &c.

In this illusion the sound is really conveyed by a tube, in a manner similar to the old and well known contrivance of the Speaking bust; the invisible girl only differing in this one circumstance, that an artificial echo is produced by means of the trumpets and hollow globe, in consequence of which the sound

no longer appears to proceed in its original direction, but is completely reversed. In the present case the beginning of the tube is in one of the hand rails just opposite the centre of the mouth of one of the trumpets, the orifice being concealed by reeds or other mouldings; the tube itself, which may be about half an inch in diameter, runs through half the hand rail, then down one of the corner posts, and from thence under the floor till it reaches a large deal case almost similar to an inverted funnel, along the side of which it rises till it comes nearly into contact with the ear of the confederate, who with a piano-forte, &c. are concealed in this case. Any question asked by a voice directed into one of the trumpets will be immediately reflected back from the concave interior surface of the globe to the orifice of the tube, along which it will be conveyed so as to be distinctly heard by the person in the deal case; and the answer returned, or a song, or a tune from the instrument, will in consequence of a similar reflection be distinctly heard at the mouths of the trumpets, but no where else; and there it will appear to come precisely from the interior of the globe. A small hole closed with glass is left through the deal case and side wall of the room, by means of which the concealed person has an opportunity of observing and commenting upon any circumstance which may take place in the room.

The author of the second communication confirms the former explanation of the Invisible Girl, except as to the manner in which it is supposed she saw the company, for he carefully examined the room of a similar exhibition at Bristol, and ascertained that there *could* be no such aperture as is above spoken of. In this exhibition there was a loose rail with eight legs; seven of which the operator always removed from their places to blunt suspicion; but the eighth was always found immoveably fixed, and that was always the leg towards the closet where the lady sat. Here too, the rail was covered opposite the mouth of the the trumpets with stained paper; but the vibration might be felt on the holes when any one answered, and peoples' hands had a little indented them by accidental pressure.

Observations.—Notwithstanding the affirmation of the writer of the second article above, that there could be no aperture for the lady to see through, in the room at Bristol, we are inclined to think there has been some such orifice in other exhibitions of this kind in different parts of the united kingdom. If such an aperture were fixed at the height of 10 or 12 feet, and the concealed seat of the confederate elevated accordingly, it would give her considerable advantage in seeing what is going forward in the room, at the same time that it would be extremely easy by means of some artificial ornament attached to the wall (of which there might be several alike) to prevent the possibility of discovering any such hole. Or without elevating the seat of the confederate, two or three plane

mirrors properly disposed, one of them horizontally just above the top of the room and disguised by a feigned ventilator, or an open-work ornament, would give her a still more complete view of every thing in the exhibition-room, and that, if it were thought proper, pourtrayed on a glass lying before her upon her musical instrument.

The general method of disposing such mirrors must be very obvious to those who are merely acquainted with the rudiments of Catoptrics; and others will see it explained in Montucla's and similar books of Philosophical Recreations, where a jealous husband is taught how to see what his wife is doing in another apartment; or a person to see those who approach the door of his house, without looking out at the window, or without having a front window at which to look out.

The method of managing this exhibition as generally performed in England, is doubtless pointed out in these letters: various other methods, all depending upon the simple principle of reflected sounds, are either described or suggested in the good Father Kircher's entertaining work entitled *Musurgia Universalis.*

Extemporaneous Printing Press, used by Country Comedians. Phil. Jour. No. 66.

ITINERANT players often print their bills by laying the damped paper upon the form of letter previously inked, and give the pressure by a wooden roller clothed with woollen cloth. Mr. Nicholson says the form of letter must be disposed in a kind of frame, having its upper surface about one-thirtieth of an inch lower than the inked face, in order that the roller, being supported by the frame, may not be obliged to rise with much obliquity, upon the first letters; and that it may pass off at the other end with equal ease. This contrivance prevents the injuring of the impression at the beginning and end of the rolling. The roller must be passed in the direction of the lines, or across the page, to prevent the bagging between line and line.

Method of preventing Wet from being introduced into Rooms, by Windows which shut together like Folding Doors. By Mr. COLLINGE.—*Phil. Jour.* No. 66.

FOLDING sashes, now very fashionable, often admit wet through their joints, thereby injuring carpets and other furniture of rooms. Mr. Collinge, thinking this evil was occasioned by the close joint acting like a capillary tube to sustain the wet till it was forced inward by the wind, and that a larger passage to convey away the water would prevent this effect; always has small semi-circular

grooves, about a tenth of an inch in diameter, ploughed in each re-entering angle of the sash-joints from top to bottom. This simple remedy is found to answer the purpose completely ; for it allows the water to run down to the bottom of the frame, where, by means of a similar channel, it is carried off to any required place of discharge.

On Mr. G. A. Eckhardt's Regulator, for powerful Machinery ; and on the Application of the Labour of Animals, as a moving Power on the Outside of a Walking-Wheel. Phil. Mag. No 105.

Mr. Eckhardt's regulator is described in a specification relative to a walking-wheel, published in the second volume of the Repertory of Arts, p. 364 ; the fly consists of an upright revolving shaft having vanes or wings, which lave in the water of a circular cistern. In justice to a very ingenious man, Mr. William Robert, of the neighbourhood of Swansea, in South Wales, it is here mentioned, that he contrived a regulator on this principle, and executed it in 1793, *two* years before the date of Mr. Eckhardt's patent ; and that it has been employed with the most perfect success, in Messrs. Lockwood and Co's collieries.

The present writer objects, however, to the use of this contrivance recommended by Eckhardt, as in such cases it is rather a *destroyer* than a regulator of power. He also points out a very serious defect in Eckhardt's mode of applying the labour of quadrupeds on the outside of a walking-wheel. In the plate accompanying the specification, an ox is represented standing with his fore feet upon a stage, fixed nearly over, but a little before the top of a walking-wheel, while his hind legs rest and act on the wheel at a considerable distance beyond its top. Now, whenever the animal's hind legs happen, by the motion of the wheel, to be carried farther than usual from his fore legs, he cannot recover himself : not only will the weight of his hind quarters, acting on an increased lever, accelerate its motion, but his hind legs, brought continually nearer into the direction of a tangent to the wheel, will give his muscular exertion an increasing effect on the wheel, as he endeavours to prevent the progressive spreading of his legs, until his belly falls upon the wheel !

This writer then remarks that man alone, from his erect position, and his facility of hanging or bearing discretionally by his hands on a fixed rail, seems capable of applying muscular power with advantage, to the convex surface of a moving wheel.

Observations.—We cannot help subscribing to the justice of this author's remarks, both as they relate to the fly and to the walking-wheel. We did not know, previous to the perusal of this communication, that Mr. Eckhardt had been anticipated in the

invention of the regulator: but the walking-wheel moved by the hinder feet of quadrupeds is a very old invention. It is exhibited twice in *Bockler's Theatrum Machinarum*, published in 1662; namely, in pl. 18, as a mover of a flour-mill, and in plate 107, as a mover of pump-work. And we have no doubt it may be found in every subsequent German Theatre of Machines: so that it is extremely probable, Mr. Eckhardt had seen some of the representations of this mode of applying animal exertion, before he took out his patent. Notwithstanding, however, that a figure of a horse or an ox eating quietly at a manger, while his hind feet are turning a wheel, makes a very pretty variety in a book of mechanical pictures; we will venture to say, it never *will* be, it never *can* be, adopted in real machinery: it never *will* be adopted in the present times; for besides that we are now in possession of far more efficacious first movers than animals, in the case here supposed, we should not have the advantage of half the animal's strength or of half his weight: farther, it never *can* be adopted, for the position, in which the animal is supposed to *stand and move*, is completely inconsistent with the natural motion of quadrupeds; such animals, when walking, move their legs diagon-wise a hind-foot and a contrary fore-foot together; whereas according to this scheme, they must move their hind-feet to and fro, while their fore-feet remain in one place; an absurdity which we should have supposed could never enter the brain of a projector of the 18th century.

As to the best method of applying human energy to walking-wheels, to which this writer adverts in his last paragraph, we are decidedly of opinion, that it is pointed out in Mr. Hardie's patent cranes, described in No. 53, of the Repertory, and commended at p. 516 of our last number.

Description of the Fire Escape, invented by John Daniel Maseres, Esq. By B. M. Forster, *Esq. Phil. Mag.* 105.

Mr. Maseres's Fire Escape consists of a suspension iron, formed like a ramhead used for slinging goods for warehouses, differing only in this, that the bottom hooks are turned up close to the upright part, to form two close rings or eyes; a flax rope, platted in a peculiar manner, in diameter about three-eighths of an inch, and in length rather more than twice the height of the window from the ground; two belts with each a buckle; a regulator, which is an oblong piece of beach wood, in which there are four holes pierced for the rope to pass through, one of them being open at the side; and a union strap, so called from its connecting the regulator to the other parts of the machine.

In putting together these parts, one end of the rope is first passed through the holes of the regulator, then through the two rings of the suspension iron; the upper belt is then passed through

a doubling of the union strap : after which the rope is tied to that belt, and the knot secured from slipping by a string ; at about a foot lower the rope is to be tied to the inferior belt in like manner ; then the upper belt and regulator are connected by means of the union strap. Now, previous to the operation of descending, the suspension iron is hung upon an iron hook fixed at or near the window frame ; the lower belt is fastened about the thighs, so as to form a kind of swing to sit in, the upper belt is loosely buckled about the chest ; and the rope, coiled about a roller to prevent it from getting entangled, is thrown out of the window to the ground. The person then gets out of the window, grasps the rope tight with his hands, and lets it run through the holes of the regulator, their friction checking its too rapid motion ; and that check operating more or less according to the number of holes and slits through which the rope is made to run.

Various examinations and precautions are necessary in the use of this fire escape, which we do not think proper to enlarge upon. Mr. Decker, No. 321, Strand, undertakes to make fire escapes of this kind ; also hoop-topped fire-sacks into which children may be put, and let down from a nursery by a sufficiently strong cord.

Observations.—In our opinion Mr. Maseres's fire-escape is too complex, too easily put out of order, and requires an attention to too many minutiæ, to deserve general adoption. It may be possible for a person devoid of all apprehension and alarm, during open day, to let himself down with this apparatus, as Mr. Forster has done, by way of experiment : but how are the straps to be arranged, the buckles adjusted, the rope run through the holes of the regulator, the suspension iron fixed to the hook, &c. during a dark night, in a room without a light, when a person just awakened is thrown into consternation by the dismal alarm of fire ? For our own parts, we should prefer a common rope-ladder to the contrivance we are now considering. Some mechanics have applied their ingenuity very successfully in devising fire-escapes to be managed by persons *out* of a house on fire, and brought to rescue those who are within from the impending destruction (see *Repertory of Arts,* N. S. vol. i. p. 439). But an apparatus tolerably simple by which a person may without any assistance from others, (an assistance which it is manifest can never be depended upon) deliver himself from the danger, is as far as we know, still a desideratum.

The method of descent by a rope, and the rapidity of motion impeded by friction, has been long known ; and the oldest contrivance we remember of this nature, is, we think, equal, if not superior, to Mr. Maseres's. It is described by the celebrated Galileo, in his *Mechanical Dialogues,* as practised by a friend of his, and is this: about a cylinder of two inches thick, and eight or ten long,

he cut a notch spirally, of one turn and a half, and no more, big enough to receive the cord he designed to use; and which he put into the notch at the upper end, and brought out at the lower; afterwards he enclosed that cylinder and cord in a wooden, or rather, a tin tube, made with clasps or hinges to open or shut lengthways at pleasure. Then, having made fast the rope above, grasping the tin case with both his hands, he hung by his arms; whence, such was the compression of the cord between the ambient tube and the cylinder, that he could stop himself at pleasure by clenching his hands closer, and by loosening his hold a little, he could let himself down gently as he pleased.

If a stirrup for each foot were attached with sufficient strength to the tin case, as it might easily be, we conceive a descent by this contrivance would be far preferable to that by Mr. Maseres's: and if by any accidental circumstance the motion of the cylinder and tin case should be completely stopped the person descending would only have to take his feet out of the stirrups, when he might slide down the rope in the usual way; whereas in Mr. Maseres's fire-escape, if a knot or other obstacle in the rope should prevent its drawing through the holes in the regulator, the person descending, having previously buckled himself in, is kept suspended in a situation little, if at all, better than the one he had just left in the consuming house. But both these contrivances, it must be observed, are liable to the objection of the person bruising himself against the wall of the house as he descends.

Composition for preventing Moisture from exuding from damp Walls; by Mr. Charles Wilson. *Trans. Soc. Arts,* vol. xxiv.

Mr. Wilson's composition or cement is thus made; boil two quarts of tar with two ounces of kitchen-grease for a quarter of an hour in an iron pot; to this add a mixture of two parts slaked lime and one part powdered glass, passed through a flour sieve, and completely dried over the fire in an iron pot; and work the whole together to the consistence of thin plaster.

This cement soon gets too hard for use; it must therefore be used immediately after being mixed, and more of it should not be mixed at once than is sufficient to coat one square foot of a wall; it continues to increase in hardness during three weeks. Great care must be taken to prevent any moisture from being mixed with the cement. A coating one-eighth of an inch thick of this cement will be sufficient for a wall slightly damp; but should it be considerably damp, then a second coat will be necessary. Plaster made of lime, hair, and gypsum may be afterwards laid over the cement.

Mr. Wilson states this cement to be of use also for flooring damp

kitchens, and wherever the prevention of wet is necessary: It will unite broken pieces or particles of Portland-stone, or marble, so as to make them as durable as before the fracture: and to prove its impenetrability by moisture it may be put into water without having its weight increased or diminished.

The Society for Arts, &c. voted Mr. Wilson ten guineas for this communication; certificates were produced of the cement having been used in three different places with good effect on damp walls.

Observations.—It appears to us that this composition is likely to answer all the purposes of its author, and that it may be applied with great advantage in a variety of other cases.

The Chinese and Indians use a composition made of lime and some other ingredients for closing the seams of their boats instead of calking them in our method; it is certainly a much cheaper mode, and it is said that their vessels secured in this way are remarkably staunch; some accounts report that they mix a species of oil with the lime for this purpose, and others that the lime is prepared for it by a process somewhat similar to that described by Dr. Anderson, (in his "Recreations") for the formation of Chunam. But if Mr. Wilson's cement has the properties mentioned there can be little doubt that it would do equally well for staunching vessels, as the Chinese composition. We hope some of the many gentlemen who have been in the East Indies and China, and must be well acquainted with the composition used there for the above purpose, will be induced to communicate it for the public good.

Method of preparing Pannels for Painting, also Colours and Crayons, and of purifying Oil. By Mr. Sebastian Grandi. *Trans. Soc. of Arts,* vol. xxiv.

Method of preparing Pannels.

Sheep's trotters are to be boiled till freed from grease, then calcined in an open crucible and finely ground, some flour well dried is to be made into a thin paste, an equal quantity of the calcined bones is to be added, and the whole is to be well ground together.

Some of this composition is to be laid over a pannel previously pumiced, and well rubbed into it with a pumice-stone. Another coat is then to be laid over the first with a brush, and when dry, the surface is to be rubbed with sand paper. A third coat, rather thinner, is to be laid over this, and if a coloured ground is wanted, one or two coats of the colour are to be added.

For painting in oil; a coat of *raw* linseed, or poppy oil, must be laid over the prepared pannel, as drying oil would destroy the absorbent quality of the grounds; which, when thus prepared, do

not crack, are soon ready for use, and produce a better effect than grounds prepared in the usual manner.

Method of purifying Oil.

This is done by bone ashes made into a paste with water, so as to form a mass; which is then to be made red hot, and immersed for an hour in a quantity of raw linseed oil sufficient to cover it. The oil, when cold, is to be poured into bottles containing a little bone ashes: in one day it will be fit for use.

COLOURS.

White colour, Mr. Grandi prepares from bones of sheep's trotters calcined in an open fire.

Brown colour, from the same calcined in a crucible.

Yellow colour, or *Masticot,* from soft brick of a yellowish colour, burned in the fire, ground with one-fourth of flake white, and then washed to separate the sand from the finer parts, which are to be gradually dried for use.

Red, equal to Indian red, is prepared from pyrites by calcining them.

Grey, from blue slate and bone ashes calcined together, then ground, washed, and dried gradually. And,

Blue-black, by charcoal of vine-stalks, burned in a close crucible on a slow fire and then well ground for use.

CRAYONS

Are to be made with bone ashes and spermaceti, in the proportion of three ounces of spermaceti to one pound of the bone ashes; the spermaceti is to be dissolved in a pint of boiling water, the bone ashes added, and the whole ground together, with as much colouring matter as shall produce the shade of colour wanted; the paste is to be rolled in a proper form, and dried gradually on a board.

WHITE CHALK,

If wanted to work soft, is made by adding a quarter of a pound of whitening to a pound of the bone ash powder; otherwise the bone ash powder will answer alone. The coloured chalks are made by grinding the colouring matter with bone ashes.

Mr. Grandi received a premium of twenty guineas from the Society of Arts, &c. for the foregoing communications, which were accompanied by certificates of their utility from several members of the Royal Academy.

Observations.—Mr. Grandi asserts that his pannels prepared as described are, as far as experience can prove, done in the old Venetian manner, to which Titian and other masters owed the perfection of their productions. This assertion we must beg leave to take with a little softening. It is generally agreed that the Venetian masters used an absorbent ground, and so far the *primary* preparation of Mr. Grandi's pannels may be of use; but when he directs that raw linseed, or poppy oil, is to be afterwards rubbed over them, it is evident that their absorbent quality must be, to a certain degree, destroyed, though perhaps not so much as if boiled oil were used; and

also it is likely that in painting on these pannels in oil, as Mr. Grandi mentions, the first coat of colour would destroy the absorbency of the ground; whereas it is generally acknowledged that in the Venetian method successive coats of colour could be applied, each of which would be absorbed into the ground; it is therefore most probable that though the absorbent ground was essential to the Venetian method, yet that it only formed a part of the process, and that some vehicle was used for the colours very different from any Mr. Grandi notices, which did not impare the absorbency of the ground for future use; at least till the whole work was completed, when it probably received a coat of some species of varnish, or other transparent composition, after which the ground ceased to be absorbent.

What Mr Grandi states of the white colour is also liable to objection; in one part of his paper he gives us to understand, that his colours will do equally well in oil and in water; the white colour he mentions, though it would probably be a good water colour, could certainly never do for oil, as from experiments frequently made by M Morveau and others, (for which see Repertory, vol. 6) metallic calces *alone* possess sufficient *body* for this purpose, all other whites being liable to lose their colour both from the oil, and the smallest quantity of any colouring matter.

Mr. Grandi's yellow colour seems a very rough, indeterminate composition, as does also his grey; for the *brick* in the one, and the *slate* in the other, are liable to be of a variety of shades, to say nothing of the coarseness of the materials in both to which the colouring matter is united; they remind us in these particulars of another colouring composition mentioned in the 23d volume of the Society's Transactions, in which *road dust* is directed to be used as a principle ingredient, and on which we animadverted in our last number, page 437.

Looms for Weaving Fishing-nets, invented by Mr. J. Robertson, *of Edinburgh.—Trans. Soc. Arts,* Vol. xxiv.

In the usual mode of netting, the meshes are formed in succession, and only a single end of twine is used at one time; in Mr. Robertsons method a number of ends of twine are employed at once: which number is double that of the meshes in each row of the net, one half of these ends are coiled on a roller as the warp is in a common loom, and on these ends the knots are formed in an imperfect state, being at first only slip knots, having all long loops, that rest on moveable hooks; the other half of the ends are wound on a sort of flat bobbins, like sheaves, each of which is supported in a small upright frame, that is capable of lateral motion either way for a little distance; these bobbin-bearers in this respect somewhat resemble the shuttles in a tape loom, and like them have the lateral motion forward and backwards conveyed to

all at the same instant. One of each sort of the ends of twine described go to form a knot; the long loops mentioned, being drawn over the bobbin-bearers, the imperfect knots then become perfect, (as the twine on the bobbins thus passed through them makes them cease to be slip knots,) all that then remains is to tighten the knots, in retracting the long loops through the other parts of the knots, by drawing back the ends of twine of which they are formed.

After having thus described the general process used by Mr. Robertson, it will be proper to notice the particular parts of the engine by which it is effected.

That half division of the ends of twine, which are coiled on the roller before mentioned, is afterwards passed through metallic tubes curved, so that each forms half of a hollow ring, large enough to include one of the bobbin-holders in its semidiameter; these tubes are all fastened to a horizontal bar, that runs across the frame, and of which each extremity is inserted into the outer edge of a pulley that turns round the rail, which supports the bobbin-holders; by this means the tubes are all moveable round the bobbin-holders in the surface of an imaginary cylinder, of double the diameter of their height; the knots are formed by these tubes, and by a row of hooks, attached so to a jointed frame that they are moveable in all directions, which do not require the bar to which they are attached to alter its parallelism to that which supports the bobbin-holders; from the ends of the tubes the twine passes to a second roller on which the net is coiled as it is formed; two of the hooks mentioned are employed for each knot, and being inserted downwards take up the twine, as it passes from the ends of the tubes to the second roller, after which they are moved, so that the twine forms one turn round each pair of them; and then being raised up, by a lateral motion they cause the round turn of the twine to have its parts so crossed that the annular tube being passed through it forms a loop knot; the loop of which is passed round over the bobbin-holder by the tube, (which in this position forms an arch above, which includes the bobbin,) so that the lower part of the loop descends through a nick in the bar, that supports the bobbin-holders, below their lower extremities: the ends of the bobbin-holders are each dove-tailed, so as to slide from left to right and back again in a dove-tailed groove that supports them in an upright position, and when the lower parts of the loops are held in the situation mentioned beneath them, they are made to move laterally, and thus pass over the lower parts of the loops and under the upper parts. In this manner the bobbins being passed through the loops, the twine which they contain is inserted through the knots, and then the tubes, being drawn back, and the two rollers, on which the twine and the net are coiled, being turned at the same time, the

knots are all drawn tight at once. To turn the rollers in the manner mentioned, there is another roller placed beneath the frame which has spokes projecting from it at right angles, by which it is moved round by the feet; on this lower roller are fixed pulleys, from which bands passing to other pulleys, attached to the upper rollers, communicate its motion to them.

No method is described by Mr. Robertson for keeping the twine tight on the bobbins, so that no more of it shall come off but what is wanted for each mesh, nor is there any contrivance for this purpose visible on the model left at the repository of the Society for Arts, &c. As this is a point essential to the evenness of the meshes, it is to be regretted Mr. Robertson did not state his method of managing it. The Society voted Mr. Robertson twenty guineas for this invention.

Observations.—In 1796, the Society for Arts gave a premium of 50 guineas for a netting machine contrived by Mr. J. W. Boswell on different principles from the above, which is described at large in the 14th volume of their Transactions. We believe also that netting machines on other constructions have been made, and particularly one calculated for fine netting.

When the art of making nets by machinery has been so long known, it will obviously be a matter of enquiry why machines have not yet been employed to any extent in manufacturing nets. Several matters tend to prevent this, of which the chief is, that there is no public fishery of any consequence on the British coasts; what formed a *gold mine*, as it was called, to Holland, seems to be despised here; and the immense shoals of fish which every year pass by our coasts from the north, are for the most part permitted to return undisturbed. The fishery at present carried on, which is a mere despicable trifle in comparison to what might be done, is for the most part managed by poor fisherman, who employ their wives and children in making nets for them, who would otherwise be totally idle, and make nets also themselves in the many long intervals that occur between their fishing excursions. A fisherman, if he were not also a net maker, must be idle more than half his time, and his family their whole time; this circumstance renders *the labour*, at present employed in making nets, so *very cheap*, that it does not seem probable any machine can make them cheaper, or that there would be any market for nets so made, sufficient to render it worth the while of any person to engage in the manufacture of them; this is not mere conjecture, as we know some persons, who, after very mature deliberation on this matter abandoned the idea of a netting manufactory chiefly for the reasons here stated.

It is possible that Mr. Robertson, or a few more in the straightened circumstances he mentions himself to be in, "having a large family to maintain by his personal labour," might employ their

own labour to advantage, in making nets by machines in the midst of a fishing district in Scotland; but we believe in the present state of the fisheries, no manufactory of nets, where hired labour was necessary, could produce any sufficient profit to remunerate its proprietors.

Method of weaving Cloth of an extremely fine Quality. By Mr. Wm. NEVEN *of Woolwich. Trans. Soc. Arts,* Vol. xxiv.

THE object of Mr. Neven's invention is to obviate the impediment to encreased fineness, in the fabric of any cloth, which arises from the construction of the reed, as usually managed.

When but a single thread is inserted in every split, or interstice of the reed, the fineness of the cloth must be ultimately limited by the degree of tenuity to which each individual slice of the reed can be reduced; but as their reduction of size below a certain degree would expose them to be broken at every stroke of the batoon, they cannot be made of extreme thinness, and consequently if a piece of above a certain fineness, corresponding to that of the reed, is woven with it, it will be open like gauze or canvass, and can never be made of a firm fabric.

Mr. Neven's contrivance for the above purpose consists in merely putting three, four, or more threads of the warp between each split of the reed, instead of a single one, as is usual. This is certainly a small, and apparently a very obvious alteration; but as it has hitherto escaped notice, its simplicity will certainly rather add to the merit of its utility in the opinion of unprejudiced judges.

When cloth woven in this manner is taken out of the loom it appears stripped, from the openness of those parts where the reed has passed through the warp; but this appearance is soon removed, by wetting it, and then stretching it backwards and forwards corner ways by the hands; which causes all the threads of the warp to occupy equal spaces, and thereby closes the irregular interstices. In cotton cloth this operation should be performed before it is sent to the bleach ground.

As a proof of the efficacy of this contrivance, Mr. Neven has made cloth from hard thrown silk in the gum, of such fineness, that it contains 65,536 meshes, or crossings, in each square inch, a number vastly greater than in any other cloth commonly known.

Fifteen guineas were voted Mr. Neven for this invention, by the Society for Arts, &c. at whose repository a sample of the cloth above mentioned may be seen.

Observations.—It is probable that the extreme fineness of some of the Indian muslins has been owing to their being woven by a

method, which, though very different from that of Mr. Neven, is still more independent of the reed, for in it no reed is used. The weft is wound in India on a flat slip of wood, somewhat longer than the breadth of the piece, in a similar manner to what twine is wound on our netting needles, and this simple contrivance answers the double purpose of shuttle and reed; as by drawing it back, while in the warp, it strikes the weft up close, that was before passed, at the same time that it inserts another thread across the piece.

This very simple mode of weaving, which is of great antiquity in India, we may with good reason conjecture was also practised in Greece in old times, from what is related in the ancient fable of the weaving contest between Minerva and Arachne; in which the goddess in her passion employs the instrument she used in weaving to beat the unfortunate maiden; a use which never would be thought of for a shuttle made in our manner, though one of the Indian construction would be very handy for the purpose. This opinion is farther confirmed by the name of the instrument for weaving both in the Latin and Greek languages; in Latin it is Radius, which literally signifies a spoke, a rod, or a long narrow slip of wood.

> Utque Cytoriaco *radium* de monte tenebat,
> Ter quater Idmoniæ frontem percussit Arachnes.—Ovid.

The Greek name κερκις is of similar import, and is moreover derived from a word which signifies to strike or beat, κερκω, probably from its use in striking up the warp, in the same manner as the Indian instruments above described.

Improved Drags for raising the Bodies of Persons sunk under Water, by Dr. T. Cogan. *Trans. Soc. Arts,* vol. xxiv.

The principal drag contrived by Dr. Cogan is formed by three curved branches of iron proceeding from an iron stalk, at equal distances from each, so as somewhat to resemble the small anchors of three or more claws used in boats; each of these branches diverges again into two at its extremity, so that thus six claws, or hooks, are formed in a circle, sufficiently near to each other to prevent the body of a child from slipping away between them, and yet at a distance from the main stem large enough to admit the body of a man between them and it

Each termination of these hooks has annexed to it, by an hand screw, a small flat oblong plate of iron, having a small sharp hook at one end; a slot, or groove, is cut through the end of each of the large branches, along which the screw and the hook may be slid forwards or backwards, so as to present a sharp or a blunt termination to each branch at pleasure: the first to be used in searching

for persons who have fallen into the water with their clothes on, the latter for those who are naked. The stem is formed into a socket at one end, into which a pole ten or twelve feet long is to be screwed occasionally; a ring is also placed at the same end, to which the extremity of a long rope is tied; the other end of the stem extends some inches beyond the part from whence the branches proceed, and is terminated in another ring, by which a second cord is to be fastened to it for the purpose of drawing it back, to disengage it from any casual entanglement with roots of trees, or other matters. To this rope a float is attached to prevent its sinking.

This drag is intended to be thrown forward to a considerable distance when necessary, and it is found that the pole will assist its projection so as to make it reach several yards farther than without it; but care should be taken that the buoyancy of the pole should not be so great as to impede the sinking of the drag.

The second species of drag is solely for the purpose of using in the hand; it consists of a long pole with two long iron prongs proceeding from it within a few inches of each other, like those of a pitchfork, but bent downwards, so as to be at right angles to the handle; each of their extremities is furnished with sliding hooks similar to those of the other drag.

Drags of each kind may be seen at the Repository of the Society for Arts, &c. who voted Dr. Cogan the gold medal for the contrivance.

These drags have been tried several times with an effigy made exactly to resemble a human body, and never failed to bring it to the surface of the water without slipping from the hold.

Machine to enable Shoemakers to work in a standing Posture, invented by Mr. A. Staas. *Trans. Soc. Arts,* vol. xxiv.

The Society of Arts have given Mr. Staas, of Porter-street, a premium of ten guineas for a shoemaker's bench precisely on the same principle as that for which they before gave a premium to Mr. Parker, which is described in our seventh number. The only difference which this has from that of Parker's invention is, that there is added to it a drawer, with a sort of table over it, and a shelf beneath it, to hold the lap-stone and other tools; a seat is connected to it by a rail that slides forwards and backwards, and a whetstone is fixed above it, on a sort of pivot, so as to be brought forward when wanted.

Observations.—The Society have certainly a right to give as many premiums as they please for the same matter to different people; but surely the grant of a premium cannot constitute that a new invention which they so lately published as the contrivance of another person. The annular cushion, with the strap passing

through it to hold the work down by a treadle, is in fact the only matter in these stands worth the name of a contrivance, and this was undoubtedly invented by Mr. Parker; as to the sliding seat, it is very doubtful whether it be not really an inconvenience, but at least it has no one perceptible advantage over a common stool of the same height; the shelf and the drawer, though they are of use in themselves, are such common additions to other conveniencies, that their being annexed to Mr. Parker's stand, so far from entitling the combination to the name of a new apparatus distinct from Mr. Parker's, does not even deserve to be called an invention.

On this occasion we are at a loss which to admire most, the modesty of Mr. Staas in calling a contrivance his (which so publicly was acknowledged before to have been Mr. Parker's), or the judgment of the Society in yielding to his claim and rewarding it. The public is indebted to the Society for bringing forward many useful matters, and this entitles it to much consideration and respect; but the greatest of mortals have been known to nod occasionally.

Aliquando dormitat bonus Homerus.

And societies we find are liable to take a nap sometimes as well as individuals.

Description of a Curvilinear Saw, invented by John Trotter, *Esq. Trans. Soc. Arts,* vol. xxiv.

The saw is formed on the edge of a segment of a hollow sphere, and is fastened at its centre to an iron mandril, moved round on two centres in any of the usual methods; a bench rises around the mandril so as to be on a level with its upper surface, on which a piece of wood, curved in the form required, is screwed down by two screw bolts, moveable in grooves through the bench, which adjust its position towards the saw, so that it may serve as a guide to another piece of wood of the same curvature, that is fastened to the piece of timber on which the saw is to act, and which directs the line of its progress as it is pressed forwards against the saw. The curvature of the guides must be the same as that of the saw.

The fixed guide has a set of jointed bars annexed to it, which oblige it, when shifted, to move parallel to its former position. They resemble in their structure a triple parallel ruler, or one of three pieces such as is described in our fourth number, page 42.

The Society for Arts, &c. voted Mr. Trotter the gold medal for this invention.

Observations.—Mr. Trotter asserts that this apparatus will be of great use in cooper's work, in making wheels, and likewise in the *formation* of timber in our naval yards: of these positions we will only dispute the latter, taking it in the sense we believe he used it.

However useful Mr. Trotter's engine may be in cutting circular curves, it certainly could be of little or no service in shaping pieces of timber so various and multifarious in their curvatures as the ribs or timbers of ships; most of which not only require the direction of their curvature to be changed frequently in their moulding, but also to have the bevels of their surfaces very different in different parts.

We are apprehensive that it would be difficult to cut with this machine a piece of timber in a circular form, whose face, or curved surface, would be at right angles to its plane surface; as the saw, being a segment of a hollow sphere, would naturally tend to form all pieces cut by it into segments of spheres also. If the saw were the segment of a very large sphere the bevel it would thus cause might be perhaps so small as to be imperceptible; but if it were one of a small sphere this defect might be in some cases injurious. Mr. Trotter has a sliding piece of steel fixed so as to be pressed by a screw against the convex side of the saw, with a view, we imagine, to remedy this inconvenience, by altering the shape of the part of the saw it touches, as the latter turns round; but we apprehend that, exclusive of the friction this would occasion, it would weaken the saw too much, to be formed sufficiently flexible to allow this sliding piece to produce the effect on it desired. Notwithstanding this circumstance the apparatus will be of considerable use in shaping fellies for wheels, and other circularly curved pieces of wood in the rough, as a bevel of surface may in them be easily set to right in the finishing; and, in fact, fellies in general require a somewhat bevel surface, as wheels are still made of the preposterous dishing form, which renders it necessary that their outer surfaces should be sections of cones.

Improved Bookbinders' Cutting Press; by Mr. James Hardie, *of Glasgow. Trans. Soc. Arts,* vol. xxiv.

This implement consists of a strong square frame, between two sides of which a moveable piece slides in grooves cut in them, so as to be parellel to the other two sides; and which a single screw, passing through a nut in the side opposite to that where the book to be cut is placed, presses forward so as to hold the latter as required. The Society for Arts, &c. voted Mr. Hardie fourteen guineas for this press.

Observations.—We apprehend that however convenient this press might be for cutting small books, yet that it would not hold large books so evenly as the two screws of those in common use.

Method of Warming Rooms by Steam, by Mr. Neil Snodgrass. *Trans. Soc. Arts,* vol. xxiv.

The following apparatus contrived for heating the apartments of a cotton-mill by steam is that which Mr. Snodgrass thinks the most perfect of those he tried.

The pipes which warm the different stories of the mill by the steam contained in them pass perpendicularly from the bottom to the top of the mill through all the floors: they are made of cast-iron, three-eighths of an inch in thickness and seven inches in diameter at the lower part of the building, and six at the upper part; they are placed in the middle of the apartments in a line, about seven or eight feet from each other; each joint of them is cast of the exact height of the story where it is to be placed, and with a sort of bracket projecting from its upper extremity; which being brought under one of the beams of the mill, is, by wedges driven between it, and the beam made to support it firmly; the joints are also secured to the beams by iron straps; and, fitting into each other by projecting sockets at their upper parts, are made steam tight there by stuffing: by this arrangement the pipes are made to perform the double office of pillars to support the building and of steam flues to warm it.

These vertical pipes all communicate at their upper extremities with a smaller horizontal pipe, that terminates outside the building in a weighted valve that permits the air to pass out from the pipes: the steam passes first from the boiler that is placed outside the building, by an inclined tube, through the wall into the lower part of the first vertical pipe near the top of the lower apartment; and from the first vertical pipe it passes by the above horizontal pipe downwards into all the other vertical pipes. At their lower extremities all the vertical pipes communicate with a small copper pipe, a little inclined from a horizontal position, that the water produced by the condensation of the steam in the vertical pipes may run along it into an hot well near the boiler, where it terminates in an inverted syphon that always retains sufficient water to prevent air entering at that part; from the hot well the boiler is supplied with water; the other extremity of this copper pipe passes through the farther end of the building, and there has a valve attached to it opening outwards, in order to let the air pass out that is driven down the vertical pipes by the steam.

The boiler, (which for a mill 60 feet long and 33 feet wide, is six feet long, three and a half broad, and three deep,) is fed and managed in the usual manner; but the smoke from its fire-place is made to contribute to the warmth of the apartments, by passing into a cast iron vertical pipe, enclosed in a brick flue at the

gable of the building, cemented close to the flue at each extremity so as to prevent any smoke to pass from it into the flue; from each story small openings are made into this flue a few feet above their floors, and another opening being made in it outside near the bottom, a current of air, heated by the smoke pipe, passes by this means through the flue into each room. The air passages may have the size of their apertures regulated by registers. The smoke passes first through a short level brick flue, before it enters the iron pipe, which intercepting all direct influence of the fire from the tube, prevents it ever becoming so hot as to be liable to crack, or in any other way transmit inflamed substances to the mill; and thus removes all danger of the mill being set on fire, from this part of the apparatus, which part considerably adds to economisation of the heat produced.

By this method the air in the rooms may be heated in the coldest seasons to 85°. And it is evident that by encreasing the number of pipes, and the supply of steam, any heat under 212° may be produced.

Mr. Snodgrass directs the principal pipes to be placed in a vertical position, because he found that when they were inclined to the horizon, they were heated most at the upper surface, which caused them to expand unequally, and because the condensed water, running down through them, obstructed the steam in its ascent from the boiler.

In some of his first experiments, Mr. Snodgrass used tin pipes, and pipes made of sheet iron, ten inches in diameter; but to them he was obliged to add valves opening inwards, to prevent the danger of their compression by the weight of the atmosphere on a sudden condensation of the steam contained by them, which valves are unnecessary for cast iron pipes.

The expense of fuel in this method of heating rooms, was found by various experiments to be less than one half of that necessary to produce the same degree of heat by the best constructed stoves.

A mill at Dornach, and two mills belonging to G. Housten, Esq. at Johnstone, in Scotland, were warmed in the above method very effectually; and certificates were received by the Society of Arts of five other mills, having been thus heated by Mr. Snodgrass to great advantage.

For this communication the Society voted Mr. Snodgrass the gold medal, or forty guineas, at his option.

Observations.—Count Rumford is the first we know of who warmed rooms by steam conveyed through pipes, on the same principle described in this communication; this he performed many years ago, as may be seen in his publications on this subject inserted in the 15th vol. of the First Series of the Repertory of Arts, &c. p. 186.

In July 1791, Mr. Hoyle, of York, obtained a patent for warming rooms, &c. by steam conveyed through pipes, for specification of which, see Repertory of Arts, vol. i. p. 300. He does not direct the number or arrangement of the pipes that were to pass from the boiler to the rooms, only so far as regards the degree of their declivity, which was to be sufficient to let the condensed water pass into a reservoir, to be placed as near the boiler as possible, for the same purpose as Mr. Snodgrass's hot well.

Mr. Green, of Wandsworth, likewise obtained a patent in 1793, for a method of warming rooms with air heated by steam, for the specification of which, also see Repertory of Arts, vol. i. p. 21; but his plan was very different from those just mentioned.

It will be seen by these facts, that Mr Snodgrass can lay no just claim to any originality of invention in his plan for warming apartments; and that his merit in it must consist entirely in the judicious application of well known principles to the particular accommodation of cotton mills and other buildings, similarly situated.

Stove for Drying different Articles, and for heating Rooms; invented by Mr. G. Field. *Trans. Soc. Arts,* vol. xxiv.

Mr. Field's stove consists of four compartments arranged one over another; the lowest contains the fire-place, and is furnished with doors, grate, and ash-pit, in the usual manner; the other three form chambers for drying whatever is required, and each has a door opening outwards; to warm these chambers, a flat flue passes horizontally over the fire-place, where it has an aperture to admit the air, from thence it ascends through one end of the first chamber, runs along its top in the opposite direction, then rises to the second chamber, again changes its direction, runs along its top, and proceeds then to the top of the third chamber, where it terminates; there is a passage, or flue, from the first chamber to the ash-pit, and apertures through the tops of the first and second chambers so placed, that they are at opposite extremities of the different chambers. The flue, for conveying the smoke from the fire-place, accompanies the air-flue described, in its various turns, and passes out at the top of the stove.

The consequence of this structure is, that when the ash-hole and fire-place doors are closed, and those of all the chambers, the fire draws the air from the first chamber, this causes the air to pass from the second into it, and from the third into the second, which obliges the air to pass through the heated flues into it, and by this means a current of hot air passes downwards through the chambers to the ash-pit, and in its passage dries any thing placed in the chambers.

Mr. Field has in his stove another set of air flues, arranged in the

same manner as those described, the extremity of which terminates in the apartment near the top of the stove, where it gives out a current of hot air to warm the room; which warmth will be much increased, if the doors of the ash-pit and of the chambers are opened.

The height of the stove is $5\frac{1}{2}$ feet, its diameter $2\frac{1}{2}$, and that of the flues four inches; the external part is formed of brick, and the internal parts of thin Ryegate or fire-stone, except the part of the air flue that lies over the fire-place, which consists of a plate of cast iron; Mr Field thinks it would act better if the stove were formed entirely of cast iron.

Mr. Field states, that the principles of this stove admit of various modifications, of one of which he gives a description, that has two fire-places outside the part which contains the chambers; he also mentions that boilers for evaporating liquors may be added to these stoves, and that as they are not confined in their dimensions or forms, or in the number of their chambers, they may be constructed so as to suit a variety of purposes; among which, he enumerates drying malt and hops, drying fruits, baking biscuits, drying linen, or piece-goods for the dyer, calico printer, and bleacher; they may be useful also in chemical elaboratories, and when connected with fires of sufficient intensity, may be accommodated to the purposes of the sugar-baker; and milk can be evaporated by it to dryness without burning or discolouring.

Observations.—Drying articles by a current of heated air, has been long since practised by Count Rumford and others. If there be any novelty in Mr. Fields' method, it will be found in the conveyance of the air from the chambers of the stove to the ash-pit, which encreases the current; and in the disposition of the chambers, which affords various degrees of heat according to the purpose wanted

The second set of air flues for warming rooms does not seem necessary for this purpose, which may be equally well, and more simply, effected by having an aperture made into the upper part of the first-air flue regulated by a register. It is probable that the air flue, and that for the smoke, would have a better effect if made wholly of cast-iron; but it is very doubtful that it would be of any use to form the other parts of any materials different from those with which Mr. Field constructed the stove here described, and the fire-place particularly would be much better if made in the same manner of bricks or fire stone.

Description of a Self-regulating Cock, used in Breweries, Distilleries, &c. by Joseph Stevens, *Esq.*— *Phil. Mag* No. 104.

Mr. Stevens contrived this cock for a reservoir filled from the Thames, at a considerable height above the low-water level, so that

it was necessary it should be filled in a short space of time, and that the cock should remain fully open during this period, and be shut suddenly when the reservoir was full. The common ball cock begins to contract the water away before the reservoir it supplies is half full, which, as it would prevent its being perfectly filled in one tide, must make this old contrivance unfit for the purpose wanted. The cock constructed by Mr. Steevens's direction answers the above condition perfectly, and one of them has been three years in use in the brewery of Cade and Co. The contrivance by which it is managed is as follows: a pipe, moveable on a center, is placed near the top of the reservoir, whose end projects over it, so that when the water rises high enough in the reservoir, it runs through this pipe into a vessel beneath it, appended from a vertical wheel of about two feet diameter, attached to the cock of the large pipe that supplies the reservoir, which cock the weight of the vessel shuts when it is filled with water; another smaller wheel is fixed to the same axis with the large wheel from which a cord or chain descends, that raises the inner end of the moveable pipe out of the water, at the same time that the large cock is shut, and thus prevents any more water from running through it; a weight attached to the other side of the large wheel opens the large cock and lets the moveable pipe down again to an horizontal position when the appended vessel is empty; from the bottom of which vessel a pipe descends as far down as the vessel falls when full; a wire passes down this pipe, to which two valves are fixed at such a distance from each other, that the one closes the upper orifice of the pipe when the vessel is at its highest elevation, and the other closes the lower end, when it is in its lowest position; this wire is connected to an horizontal lever that turns on a pivot at its further end over the reservoir, which lever has a float fastened to it in the space between its pivot and the side of the reservoir; this float keeps the lower valve close against the lower orifice of the pipe above mentioned, when the appending vessel is in its lowest position; but when the water becomes low enough in the reservoir to admit the float to fall down lower, the lever also descends and with it the wire and the valve, which opens the lower end of the vertical pipe, and lets the water out of the appending vessel; and this causing the counter weight to preponderate, it thereby turns round the large wheel, opens the large cock of the great pipe that admits the water to the reservoir, and raises the appended vessel again to its first position.

Description of Mr. Arthur Wolfe's *improved Piston for Steam Engines.—Phil. Mag.* No. 104.

The use of common pistons has this inconvenience, that the stuffing cannot be tightened about them, without taking off the head of the cylinder, which gives so much trouble, that the

engine is often allowed to work with the stuffing in such an imperfect state, that much steam passes by it to waste, which causes a proportional loss of fuel.

Mr. Wolfe has contrived two methods to perform the above-mentioned operation without removing the lid of the cylinder. In the first method an internal lid fits over the piston with a rim projecting downwards annexed to it, the lower part of the piston rod just above this lid is formed into a skrew, on which a circular nut works, by turning which the projecting rim is forced down on the stuffing; the circular nut has teeth cut on its edge, in order that a pinion placed beside it may turn it round when it is itself turned. This pinion has a square axis, on which a key fits to turn it, that passes down through a hole in the lid of the piston, which hole is stopped, when the engine is at work, by a piece which screws over it.

The other method of performing the same design is more calculated for large engines, in it six or seven screws near the circumference of the lid are made to turn round altogether, and press down the lid, by each having its head formed into a toothed wheel, which interlocks with another toothed wheel, in the center of the lid that revolves round the piston rod; the top of one of the screws is formed into a square projection, by which it can be turned from without in the same manner described in the account of the other method; the motion of this screw is by the central wheel communicated to all the rest.

Observations.—This seems a valuable improvement, and is certainly very ingenious and simple.

Account of a Machine for crooking Wires for Cards, employed in carding Wool, or Cotton, invented by Mr. Joseph Beard. *Trans. Soc. Arts,* vol. xxiii.

This machine is little more than a foot square, and is put in motion by a winch, which turns two rollers, that draw in two wires at the same time from two reels, on each of which a coil of wire is placed; as the wires advance they are cut and double crooked by the machinery; and then drop into a proper receptacle.

This machine is stated to work with great expedition, and to waste less wire than other machines used formerly in the manufacture of cards; some of which crooked the teeth, and others cut them, but none before performed both operations at once.

The machine has been worked to advantage for three years for Mr. Appleton of Coggeshall, and certificates from him and Mr. Honeywood of Marshall, have been forwarded to the Society for the Encouragement of Arts, &c. of its good performance, and the excellence of the cards made with teeth manufactured by it; the Society voted Mr. Beard as a reward for his ingenuity, the silver medal, and forty guineas.

REVIEW OF SPECIFICATIONS OF PATENTS,

PUBLISHED IN THE REPERTORY OF ARTS, &C IN THE MONTHS OF JANUARY, FEBRUARY, AND MARCH, 1807.

MR. EDWARD HEARD'S *Patent for obtaining Inflammable Gas from Pitcoal, in such a State, that it may be burned without producing any offensive smell. Dated June,* 1806.—*Rep. of Arts, &c.* No. 56, *New Series.*

THE methods described in this patent are twofold. In the first, the coals are stratified with lime in the retort, or other vessel in which they are distilled. In the second, the gas produced from coals distilled per se is passed over lime contained in a heated tube. After the gas has been conducted into a refrigeratory, and all the condensible vapour has been deposited, it is burned in the usual manner.

Mr. Heard states that he has detected sulphur in most of the coals used in this country; and he imagines the disagreeable smell produced by burning the unrefined gas arises from the sulphureous acid gas that is thus produced. He therefore uses lime to form with this sulphur either a sulphuret, or a hydrosulphuret. The other alkaline earths, or the oxides of those metals that possess a strong attraction for sulphur might be used, but lime, especially when stratified with the raw coals, is the most economical.

Observations.—We have little doubt but that the means described by Mr. Heard will have the effect of depriving the gas of its offensive smell, if that smell proceed, as Mr. H. considers it does, from the sulphurous acid gas, generated by the combustion of the gas obtained in the ordinary way from pit coal; but although we may allow that the sulphurous acid-gas might cause part of the offensive odour, yet we cannot help strongly suspecting that even a greater part arises from a position of hydrogen which unavoidably escapes deflagration. And should this be the case, it is obvious Mr. H's specification does not afford the means of removing the cause of complaint.

The public papers have been filled of late with the proposals of a Mr. Winsor, to establish a company for the use of a process, which he pretends to be the original of this patent, and in which he calculates upon an immense profit accruing to the subscribers, from a very small deposit. The object of these proposals is so extravagant, that they naturally challenge enquiry; and as the subject now occupies a considerable share of public attention we trust our readers will approve our going a little into the detail of it.

Mr. Nicholson, in answer to a query by one of his correspondents, has in his Philosophical Journal, entered upon this subject. He observes that the first enquiry that presents itself regards the validity of the patent, which he apprehends is of little value. The inflammable nature of the gas from coal was discovered previous to the year 1691, by the Honourable Robert Boyle, as appears by two papers inserted in a preceding part of the present number, (viz. page 19.) Lord Dundonald used the gas from coal to give light many years since, and it was shewn in public by several persons. A Mr. Murdock also put it in practice upon a large scale in 1792 and 1798. So that Mr. Winsor cannot by any means be esteemed the inventor as to the public use of the gas. Nor is this the only legal objection urged by Mr. Nicholson against the patent, for by the statute law of the realm, patents cannot be held as joint property among more than five persons; now Mr. Winsor proposes to share his patent among all the subscribers, a step which would of course render the whole void. Mr. Winsor seems aware of this objection and therefore speaks of taking in subscriptions on the condition that a company be established by an act of parliament. If this act could be obtained, no objection as to the legality of the patent, so far as regards this point, could be started, but Mr. N thinks it is very improbable that parliament would consent to such a measure. And in the mean time, Mr. N. asks what security have the subscribers for their deposits? Mr. Winsor says his patent is vested in four respectable gentlemen; but Mr. N. replies, that he has not thought proper to inform us who they are, notwithstanding Mr. N. argues such information is certainly necessary for calming the minds even of the most inconsiderate person in respect to the safety of his deposit, which deposit, at 5*l.* on each share, amounts, according to his scheme, to no less than one hundred thousand pounds.

In opposition to these remarks, Mr. Winsor has published a small pamphlet. The flimsy texture of this defence, and the evident symptoms of the soreness of detection that it exhibits, bear sufficient testimony to the weakness of the part that it is designed to strengthen. When divested of the extraneous declamation in which his arguments are smothered, they are simply these:

First, He boldly asserts that although the inflammability of the gas from coal has been long known, yet that no one had used purified gas before his first patent in 1804. The incomplete specification of his patent he ascribes to a persuasion that chemical processes cannot be so described as that the same result can be obtained by others, of which assertion however he does not venture to give any proof. He therefore merely stated his process in general terms, and left the particulars to be shewn in his lectures, in which, notwithstanding his boasts to the contrary, he merely gave a jejune account of light and the other imponderable bodies

connected with it, and much declamation respecting the uses to which his invention is applicable. He accuses Messrs. Philipstahl and Heard of having surreptitiously obtained their knowledge of the subject from him. It were unnecessary to enter into this detail, the histories as told by himself being more highly seasoned with invective than the plain simplicity of truth requires.

In respect to the formation of so large a company, as he proposes, he says, that he retains the patent right to himself, and merely licenses the company to exercise it, taking himself a brokerage or commission on their profits; by this means he flatters himself he is within the statute; concerning which we are inclined to think he will find himself mistaken.

The safety of the subscription which he solicits, he rests upon his having been a merchant, and having passed 100,000 *l.* a year through his banker's hands; and further observes, that he could refer for his character to some royal personages with whom he has conversed. These reasons, especially the last, must no doubt be perfectly convincing to those whom he wishes to prevail on to form a part of his company.

Mr. Winsor affects to treat lightly the observations of Mr. Nicholson, and roundly asserts that they have increased the number of his subscriptions. We think it would have been wise if Mr. W. had given the names of some respectable persons, who had come forward in consequence thereof to grace his scheme. In lieu of this he merely mentions a Mr. Desanges, of Spittalfields, who had made gas lights himself, but who was willing to join the company, and pay for a licence under his patent!

In spite of Mr. Winsor's assertions, we cannot consider his scheme in any other light than a mere bubble, and that if the facts stated by Mr. N. be correct, and of which, as far as regards Mr. Murdock's prior application of the gas lights to public use, we have no doubt Mr. W's patent right will fall to the ground; independent of which, we think, the defects and obscurity of his specification will render his patent untenable.

Mr. Heard's patent, which Mr. W. calls a pretended discovery, stands on a different basis, that of preventing the disagreeable and noxious effects of the gas. We have no knowledge of this object having been accomplished before Mr. Heard's patent, and if his means prove effectual, the great desideratum is attained, which we pointed out in our observations on Mr. Henry's valuable paper on gases obtained from coals, in the second Number of this work, and to which we beg leave to refer such of our readers as are interested in this subject.

We cannot leave Mr. Winsor without noticing the illiberality and grossness with which he treats Mr. Heard. Mr. Winsor, as appears from his own statement, had originally engaged Mr. Heard to read the lectures at the Lyceum, and make experiments for him.

He wishes to insinuate, that Mr. Heard acquired in his service all the chemical knowledge which that gentleman possesses; but the only presumption he can produce for this is, that Mr. Heard was at that time not very abundantly stored with the gifts of fortune. To us the presumption of a contrary progress of knowledge, viz. from Mr. Heard to Mr. Winsor, seems far stronger. The former was professionally a chymist; the latter by his own account engaged hitherto only in mercantile transactions, and incapable of even conducting the experiments necessary for his purpose. Nor does Mr. Winsor appear even now to have made much progress in chymistry or natural philosophy, as far as we can judge by the silly questions he challenges Mr. Nicholson to answer. In this curious specimen of his pre-eminent knowledge, Mr. Winsor not only talks of the "sulphureous alkaline ammonial and empyrheumatic oil-tar particles, which coal-smoke keeps in solution," but even asks if Mr. N. can "guess how many pounds of gas, he, or any man of equal weight, has in his physical composition, and what analogy this bears to his vital, mental, and bodily organization."

Mr. Robert Newman's *Patent for Improvements in the Construction of Ships, Barges, and other Vessels. Dated Sept.* 1800.—*Rep. of Arts,* No. 56, *New Series.*

Mr. Newman's specification describes three alterations in the usual construction of vessels: the first is a method of attaching two rudders to them abaft in the direction of the sides, instead of one in the central line: the second consists of a new form for the sides and bottom, which the patentee directs to be shaped concave externally: and the third is a sort of combination of the other two, by which the run of a ship of the form last described is accommodated to two rudders. The advantage of the first he states to be an increased facility of steerage; of the second a greater stability and making less lee way with light draft of water; and of the third the diminution of resistance without lessening the stability.

The two rudders are described as attached solely to flat-bottomed strait sided vessels by a vertical plane in the direction of each side abaft, similar to that by which the rudder is fastened to a coal barge; they are to be of much smaller dimensions than single rudders, and are to have their tillers connected by ropes or chains with a steering wheel, or other engine for the same purpose, placed in any part of the vessel most convenient. The form directed for the sides will be best conceived by supposing a transverse section of a vessel, composed of segments of three large circles, whose centres are external to the vessel, two of which segments form the sides, and the third the bottom. The third improvement

is described by the patentee as a run or shape abaft, made by "contracting the capacity internally to a form resembling that of a swallow's tail;" which description tends rather to confuse than explain. It is in fact very difficult to describe without drawings, but perhaps may be better conceived by supposing a parallelipiped of wood hollowed out beneath at the aft extremity, so as to form a segment of a hollow cone, pointing obliquely downwards, whose base extends across from side to side at the water line of the stern, and whose apex reaches downwards and forwards to the keel, the sides of the parallelipiped being left untouched, to afford supports for the two rudders.

The patentee mentions that the head of the vessel may be formed round, though he does not conceive that if it were formed square, like the end of a chest, the angles would cause any retardation to the progress of the vessels.

Observations.—The plan of attaching double rudders to barges would certainly make them much more easily steered, and, from their reduced size, would be much less cumbersome in a river, than the large rudders, now in use; there can be no objection to adding them to other vessels, except the expence, if the manner of doing it is so adapted to the shape of the vessel as to cause no more resistance to its progress than a single rudder.

As to the concave sides and bottoms they are obviously extremely objectionable, from tending to make the ship very weak, and hard to be kept staunch, and from the greater quantity of compass timber they would require which would render them very expensive.

The third improvement would also require much timber of extraordinary curvature, hard to be procured and of course very costly.

The opinion relative to the square head of a ship is too obviously erroneous to need comment.

Messrs. Clarke *and* Bugby's *Patent for Improvements in a Machine for Spinning Hemp, Flax, Tow, and Wool.—Dated June,* 1806,—*Rep. of Arts, &c.* No. 56, *New Series.*

The specification of this patent describes a machine on similar principles to that called the Mule in the cotton manufacture, which is applied to spin flax or hemp, by having its fluted rollers and parts connected with them placed a considerable distance asunder, one above the other, so as to suit the long staple of the material in drawing out the slivers, previously formed of it. To the usual machinery of a mule there is added in this a contrivance, by which the carriage that contains the spindles returns spontaneously,

by a weight and cord over a pully, after it has been first drawn forwards the proper distance from the rollers. A new kind of traverse for distributing the yarn on the bobbins is also connected with this machine; and two or three different methods are described, any of which may be used with it, by which the want of elasticity in hemp or flax is compensated, one of which consists of having a long large wire holder placed vertically by each spindle, with its top formed into an horizontal ring, over the bobbin, through which the yarn is to pass to it. The bobbins are directed to be six inches long, of an inch and quarter diameter at the bottom, and three quarters of an inch at the top; their bottoms are to be turned concave, that by touching the seats of the spindles on which they rest, at their circumferences only, they may have a greater hold of the latter in turning round.—The machine may be used to spin long stapled wool as well as flax and hemp.

Observations.—The specification of this patent is very long, and seems very fairly drawn up with intent to describe every thing clearly; but we have not attempted to give a very minute account of it, as it could not be readily understood without a plate.

It does not appear from the specification whether this machine is the first application of the mule principle to spin flax or hemp, or that the patent merely relates to improvements on some machine of the kind before made; the long and minute description of all its parts seem to countenance the first idea: and if so we shall not hesitate to express our approbation of the ingenuity and judiciousness of the thought, for certainly the mule principle is much the best adapted for spinning long staples of every sort.

The contrivance mentioned for compensating the want of elasticity in flax or hemp, is much to be commended; but that for making the carriage of the spindles return of itself seems to us of no utility, as it must add to the force requisite for drawing out the carriage as much as it assists in the return: the contrivance also for distributing the yarn on the bobbins does not appear in any respect better than those in common use.

Messrs. Fricker *and* Clarke's *Patent for a new Mode of decorating Walls of Apartments in Imitation of Fine Cloth, dated August,* 1806.—*Rep. of Arts,* No. 56, *New Series.*

The method proposed by the patentees for decorating walls is to cover them with coloured flocks, composed of the cuttings of woollen cloth, cotton, or silk; this is done by a cement or mastich formed of a pound of *Gum anima* boiled with one gallon of linseed oil, and one gallon of spirits of turpentine, to the consistence of

tar; a mixture of one part of this mastich to three parts of colour, the same as that of the flocks, ground in oil well boiled together with it, is to be laid over the walls previously well pumiced, and washed with two coats of strong size; and while the mastich is moist, the flock is to be blown against it, by a bellows connected with a box in which it is contained.

Observations.—Flock paper is a very old invention, and was once in general use. The method of the patentees will however excel the old flock paper much in appearance, as the seams caused by the joinings of the paper will not be seen.

Mr. George Barton Alcock's *Patent for improvements in Lamps.—Dated Jan.* 1806, *Rep. of Arts, &c. New Series.*

Mr. Alcock's specification describes two lamps of new construction; the first of which is contrived so that oil rises from a reservoir beneath the lamp to a level with the burner, by the expansion of air artificially compressed over the surface of the oil; the oil is prevented from running over above the burner by a float and valve placed in a tube of the same height as the burner, in the centre of the lamp, (which in the drawing is represented of Argand's construction), this valve is connected with the float by a wire so as to close the pipe, by which the oil rises from the reservoir when the float ascends, and opens it again when the latter descends. The consequence of which arrangement is that, as soon as the oil rises in the tube to a certain height, the float is so buoyed up by it as to shut the valve; which opens again to admit more oil, when that in the tube is consumed so as to be below the due level; from this central tube horizontal pipes pass to the cylindrical wick-holder of the lamp to convey the oil to it. The air is compressed by a syringe furnished with a valve, in the same manner as an air pump, which is inclosed in the top of the reservoir.

In the second lamp the oil is raised in a different manner: a large tube forms the reservoir for the oil beneath the burner, and in this a piston is raised from beneath by a rack, which descends from it, and is worked by a pinion: When the pinion is turned round, the oil above the piston rises by the ascent of the latter to the height required. This lamp is represented with a common burner, but it is evident the principle of it may be applied to an Argand burner, if thought fit.

Observations.—The first described lamp is very ingeniously contrived, particularly as to the management of the valve. The second lamp though not so perfect, as it will not operate spontaneously as the first does, would however be sufficiently convenient

for the table of a family, as whoever sat next it, could in an instant raise the oil high enough in the tube, to last for an hour or more according to its size. Both lamps have the advantage of not having any of their light intercepted by the reservoirs, as these lie entirely out of the way of the light beneath the burners; in the common Argand, and fountain lamps, the interruption of the light by the reservoirs is found to be a considerable inconvenience.

Mr. William Hyde Wollaston's *Patent for an Instrument whereby any Person may Draw in Perspective, or may Copy or Reduce any Print or Drawing. Dated December,* 1806,—*Rep. of Arts,* No. *57, New Series.*

In this instrument two plane reflectors are fixed at such angles with regard to each other, that the objects intended to be delineated are seen after reflection from the second mirror, as though they were on the same plane as that whereon the paper is placed which is to contain the drawing. These plane reflectors may be either common mirrors with a silver coating at the back of each, or two contiguous faces of a glass prism, in which latter case the image will be produced by what is called prismatic reflecton. In either case the most convenient position, in which the reflecting surfaces can be arranged, will be such as will cause the rays proceeding directly from the object and falling as incident rays upon the first surface, after reflection from thence to the second, to emerge from that second reflecting surface in angles of 90 degrees with the direction of the original incident rays: for, in these circumstances vertical objects may be projected upon a horizontal plane, and the instrument will be adapted to drawing upon a horizontal surface. Now, if two plane mirrors are used, the incident rays upon the first will make right-angles with the emergent rays from the second, when those mirrors are fixed so as to make angles of either 45 or 135 degrees with each other. In this case the mirror which first receives the rays from the object may be entirely silvered at its back; but the second mirror is only to have a sufficient portion silvered to reflect the image of the proposed object to the eye; and thus to allow the paper, on which the drawing is to be made, to be seen either through an opening of the silvering or past the edges of the same, by one portion of the eye, while the double reflected object is seen in the silvering by the other portion of the same eye. When prismatic reflection is employed the prism must not be triangular as usually constructed, but quadrangular, and the two reflecting surfaces (to produce an angle of 90 degrees between the first incident and second emergent rays) must make an angle of 135 degrees, while the opposite

angle must be one of 90 degrees, and the other two angles may be either respectively equal or unequal at pleasure: then one of the faces which make right-angles with each other is to be turned towards the object or objects to be delineated, and the rays, after passing through that surface and reflection from the two next faces, will emerge from the fourth under the proposed angle.

The mirrors or other reflecting surfaces are mounted in a proper frame, and supported at a suitable distance from the paper intended to receive the drawing: and, when necessary, either a double concave or a double convex glass, may be fixed in the frame and properly adjusted, to produce distinct vision when the apparatus is used by short-sighted, or long-sighted persons respectively. These concave or convex glasses may conveniently be made of 12 inches focal length; the instrument must then be supported at the distance of 12 inches from the paper; a distance which is convenient enough in other respects.

Observations.—This instrument it should seem is intended to supersede the use of the camera obscura; though in our estimation there are various constructions of the portable camera obscura, which are far superior to Mr. Wollaston's invention in facility of application to nearly every purpose that can occur. Indeed, as a perspective instrument we should even prefer that invented by Sir Christopher Wren, and described in Vol. iv. No. 45, of the Philosophical Transac. (Part. II. New Abridgement), or Vol. ii. of Hutton's Montucla's Recreations. The use of Mr. Wollaston's instrument pre-supposes some practice in drawing, as it takes for granted that a person can copy upon one plane surface what he sees upon another; whereas neither Wren's instrument nor the camera obscura require any such knowledge or skill. Now a perspective instrument, if well contrived, should enable a person to take the outlines of a view who has no skill whatever in drawing, so that Mr. Wollaston's contrivance, failing in this essential particular, does not enable us to accomplish what is naturally expected by the aid of such an instrument; and is, therefore, inferior, not only to the above-mentioned, but to various others, which have been devised for the same purpose at different times.

We have not seen or used this instrument, and therefore only speak from our experience in the use of other optical instruments, when we say that we apprehend Mr. Wollaston's would soon be abandoned, if there were no other objection to it, on account of the fatigue it would occasion to the eye. We know that in making observations with Hadley's Octant, Talbot's Sextant, Bickford's Quadrant, and other instruments on the catoptric principle, in which one (or more) of the glasses is partly silvered and partly transparent, the eye is much strained and wearied by accommodating itself to the reception of both the direct and reflected rays for distinct vision;

and if such fatigue is occasioned during the short interval necessary to make an observation in surveying or in practical astronomy, what may we not expect when the organ experiences a similar strain, during the much longer period requisite to sketch merely the outlines of a moderate landscape?

We trust we are not disposed to cavil at trifles; but we confess we were disappointed on the perusal of Mr. Wollaston's specification to find it deficient not only in that perspicuity which might naturally be expected from a gentleman of his scientific eminence, but in that which is required to enable a workman of moderate capacity to construct the apparatus from the directions given him by the patentee. The intermixture of definitions with the descriptive part of the specification (such as those of incident and emergent rays, &c.) gives an air of precision to parts, which is not fully realized on the whole. For, although the instrument contains only two mirrors, or two reflecting surfaces, each of these is, by the patentee in different parts of his specification, called the *first* mirror or surface. A workman who attempts to construct this instrument according to the specification, will "use for the *first* reflector a glass partly silvered," and he will place it to receive "the rays proceeding from the object"; that is, he will place it in the wrong situation, and completely defeat the proposed object of the patentee, by endeavouring to conform to his directions.

Mr. SCHMALCALDER'S *Patent for a Delineator, Copier, or Proportionometer, for the Use of taking Profiles, tracing Landscapes, copying Pictures, &c. Dated December,* 1806. *Rep. of Arts,* No. 57, *New Series.*

THE principal part of this instrument is a straight hollow rod of brass, or other metal, or even wood, of any convenient length from 2 to 10 or 12 feet, carrying at one end a fine steel tracer, and at the other a tracer, a cutter, or a pencil, as occasion may require: this rod is graduated by a series of equal divisions, and has its exterior surface fitted to a cylindrical aperture in the globe of a ball and socket, so that any part of the rod may be brought to the centre of that globe and fixed there. Thus the rod may be divided into two parts in any proportion, while a free motion may be readily communicated to it, about the centre of the ball and socket; the various tracers, points, &c. are easily adjusted by means of screws.

Now in using this instrument to cut profiles, the method is, after resting the person's head against a piece of wood lined with leather, to begin tracing at the back and carry the tracer gradually over the exterior of the head and face, while the cutter at the other end of the rod will be cutting out the profile in an inverted position from a

proper material attached to a swinging frame, which hangs vertically when left to itself. The size of the profile will manifestly depend upon the proportion of the parts into which the rod is divided. Again in copying a drawing, it must be attached to a swinging frame, in such manner that while the tracer at one end of the rod is carried gradually over all the parts of the drawing, a pencil fixed at the other end of the rod shall describe similar parts in any assigned proportion upon a piece of paper or of ivory fixed to another swinging frame properly suspended. Lastly, in drawing landscapes, &c. from nature, the operator moves the rod so as to keep the tracer and object to be drawn together in sight while he looks along the rod, then will the pencil describe the object upon the proper substance attached to the swinging frame.

Observations.—The idea of taking profiles by means of a tracer, applied in succession to the different parts of the head and face, the body being steadied by a proper rest, is not new; it was advanced some time ago by Mr. Hawkins in the specification of a patent published in the Repertory of Arts, vol. iv. New Series. The principle suggested by Mr. Hawkins is exactly the same as that by Mr. Schmalcalder; and we are therefore inclined to think that in this respect the pretensions of the latter infringe upon the legal claims of the former. Besides this, there is a general similarity between the proposed objects of both patentees; since each applies his instrument to the purposes of copying drawings, of sketching landscapes, and of taking profiles; though in addition to these, Mr. Hawkins had some other points in view which do not appear in the contemplation of Mr. Schmalcalder. As it is a matter of doubt whether Mr. S. may have seen Mr. H's specification, we hesitate in giving him that commendation for the simplicity of his contrivance, which we would otherwise have thought his due. Both contrivances however, are merely new applications of old instruments; Mr. H. took for the bases of his apparatus, the pentagraph and the paraller ruler, while Mr. S. adopts the principle of the proportional compasses, and can therefore command a greater variety in the relative magnitudes of the original and the representation.

Mr. Vazie's *Patent for Improvements in the Measures and in the Machinery to be used in making Bricks and Earthen Ware, and for Improvements in the Carriages that remove the said Articles. Dated November,* 1806. *Rep. of Arts, No. 57, New Series.*

The first of these improvements is in the measure by which the quantity of coals used in the manufactory is to be adjusted. To determine exactly the dimensions of the conical heap that reaches

above the top of the coal-bushel measure, Mr. Vazie recommends a moveable semicircular bow of the same diameter as the measure, upon which there are suspended three moveable bobs or pins, one of which will, when the bow is placed vertically, reach just to the top of the required conical heap (of 7 inches altitude), while the other two will each reach to the middle of a slant side of the said conical heap. Whence by raising this bow and its appendant bobs over the top of the measure, the due size of the conical heap may be adjusted; at least, just under the bow; the remaining part is regulated by a straight rule, in length equal to the slant side of the cone, and which is to be applied in different positions from the vertex of the cone to the upper edge of the coal-measure.

The second improvement relates to pump work, and consists in making use of two moveable pistons for every thirty feet the water is to be raised; these two pistons are placed at the invariable distance of two feet from each other, the lower one being connected to the upper one by a bar and a hook and eye joint; so that the two pistons rise and fall together. And in order to prime this pump where there is more than one set of pistons applied, a funnel or small cistern is placed at a short distance above the lowest set, a cock with two plugs, or two separate cocks, being fixed in the pipe which connects the funnel with the pump.

The third improvement has reference to the carriages employed in the removal of bricks, &c. Mr. Vazie recommends that the word *unhired* in large characters should be painted on a signal board standing vertically in a suitable part of the cart; when the carriage is hired the signal may be turned down into a horizontal position by means of a joint like that of a clasp-knife. In the night time a lamp is made use of, which illuminates characters cut in a thin board or shutter: when the carriage is hired the shutter is turned down and the lamp alone appears. Similar contrivances are recommended for hackney coaches.

The fourth and last improvement has for its object the reduction of friction in the cart-wheels. To this end Mr. V. recommends for the wheel boxes oil prepared as follows: Take whale blubber, and put it into a pan with a moveable cover, place this pan upon a boiler, and extract the oil by the heat of the steam arising therefrom when boiling; then put the oil into a separate steam pan with water, that it may be purified from heterogeneous matter. Oil thus prepared may also be burned in the signal lamps above mentioned, as it furnishes a strong light.

Observations.—Mr. Vazie's specification, considered in connection with its title, and its real objects, is altogether a very curious production. The proposed objects of the patentee, are "improvements in the measures and machinery for making bricks;" yet these improvements when enumerated have no necessary connection with brick-making, nor have they any necessary connection with

each other. Instead of including all in one specification, these improvements ought to have been secured by four distinct patents; that is, if either of them were worth securing at all—a point respecting which we entertain very considerable doubts.

The proposed improvement in the coal measure is an addition, in our opinion a clumsy one, to a scheme formerly proposed by Mr. Vazie, and commended by us, (at least as far as relates to the object) at p. 160 of our fifth number. The fixing of the semicircular bow with its appendant bobs to hinges is a disadvantage, to remedy which Mr. V. calls in the aid of the ruler equal in length to the slant side of the conical heap. The contrivance is thus rendered unnecessarily complex. We should recommend in preference an angular ruler in form of the letter V inverted thus Λ. The angle between the legs of the ruler should be equal to the vertical angle of the conical heap, as determined by observation, and the length of each leg equal to the slant side of that cone. This ruler placed in different situations upon the top of the measure, though always in a vertical position, would furnish a very adequate guage. Though in our estimation it would be better still to have no guage at all; but instead of it to increase the depth of the measure by one-third of the allowed height of the heap, which would of course make the cylindrical measure equal in capacity to the complex cylindro-conical measure now in use. All this, however, is upon supposition that there must be a deviation from the legal standard bushel, in the admeasurement of coals; but since it is allowed on all hands that there is need of the interference of the legislature in the adjustment of coal-measures, we should rather wish to see it enforce the return to the standard bushel, as was done some years ago with regard to corn measures; such a step would, as in the case adverted to, cause a great clamour among the prejudiced and the interested; but it would be merely a transient ebullition, while the resulting advantages would be permanent.

Mr. Vazie's modification in the construction of pumps may in some few instances be productive of benefits: but what particular advantages the patentee expects from it, we know not, as he has not stated them in his specification.

The improvement, as it is called, relative to the carriages employed in removing bricks, bears with it an air of the *ludicrous*, on which we know not how to comment. We will venture to say that there are not six brickworks in the kingdom, where the adoption of the contrivance would not be thought perfectly ridiculous. And as to Hackney coaches, it is sufficiently easy to tell whether they are hired or unhired, without having recourse to the signals recommended by Mr. Vazie.

We shall not hazard any opinion relative to the reduction of friction by the oil prepared according to Mr. Vazie's direction; for it is impossible to tell whether it is preferable to many other substances used for the same purpose, otherwise than by

making a series of comparative experiments: such experiments we would recommend the patentee to institute; and if the results should be found favourable to his views, to lay them before the public.

Mr. ECKHARDT'S *Patent for certain Improvements in the Mode of covering or enclosing Books, to secure them from the Observation of any Person but the Owner, and to preserve them from Injury. Dated December,* 1806.—*Rep. of Arts,* No. 58, *New Series.*

THE present invention is an avowed extension of a principle formerly devised by Messrs. John and Joseph Williams, and in 1799, secured by a patent for the express purpose of producing freedom in the opening of all sorts of books by means of a firm back, applied to a book *before* it is covered. See Rep. of Arts, vol. xii. p. 89. Mr. Eckhardt produces the same effect upon all kinds of books *after* they are covered or bound, provided they are sufficiently pliant, by a similar firm back applied externally, to which flaps are attached by hinges of any kind; and to these flaps ledges are connected by hinges, so as to enclose the book completely on all sides. Stays or pivots are placed within this firm box to hold down the cover of the book; which will cause the book so enclosed to produce a flat surface when opened.

When supporters are required to rest the hand upon in writing near the bottom or edges of the book, Mr. Eckhardt accomplishes it by ledges on the proposed part, having a joint, and extending across one or both sides of the book: these rests possess an ability of being elevated or depressed at pleasure, with a power of being rendered stationary, by means of stops affixed to the flaps, or other suitable means. The whole may be secured by a lock or other fastening.

Mr. BELL'S *Patent for an improved Method of making Smoothing Irons, or Sad Irons, Plane Irons, and various Edge Tools.—Dated, Dec.* 1806, *Rep. of Arts,* No. 58, *New Series.*

1. To prevent the inconveniencies of dirt and smoke on the lower faces of flat irons, and to save the time and trouble of cleaning them, Mr. Bell has contrived a thin case or slipper of steel, cast iron, or other suitable substance, which is fined to the iron after it is taken from the fire by means of a spring or other fastening. The same contrivance serves also to prevent linens, muslins, &c. from being scorched by too hot an iron: for while the slipper, being thin, soon communicates

a moderate heat to the article intended to be ironed; it will not be quite so likely to scorch as an iron without such slipper.

2. To prevent the handles from becoming so hot, as to need ironholders, Mr. Bell constructs them in pieces separate from the irons: but so as to be readily connected with them, on one part by a pivot slipping into an eye, and on the other by a screw and spring.

3. To prevent injury to the quality of the steel from the severe heat required in welding, Mr. Bell makes his plane iron stock with a vacant part, to be afterwards filled up by a thin piece of steel made exactly to fit it: he then tins the two parts intended to be connected together, and for the purpose of uniting them he runs between them pewter solder, or any other kind of solder which does not require an extreme heat to render it fusible. This method he also proposes applying to the manufactory of chisels and other edge tools.

Earl of Dundonald's *Patent for Improvement in Machinery for spinning Cotton, Silk, Wool, or Flax, &c. Dated Nov.* 1805. *Rep. of Arts, &c.* No. 58, *New Series.*

The improvements described in the specification of this patent consist of additions and alterations in the spindles and the bobbins, and other parts connected with them; these are of four different sorts, which are classed under the designation of as many numerated spindles.

In the improvement called Spindle, No. 1, the spindle differs from that in common use, in not having its bobbin made to rest on the copping rail, their contact being prevented by a brass circle or whirl, which is formed so as to rise and fall on the spindle at the same time that it turns round with it, the spindle having a groove cut in it, into which some projecting part of the brass whirl enters a sufficient way, to insure the communication of motion. The brass whirls, and the bobbins supported by them, are moved up and down by the copping rail; and the thread is made to wind on the bobbin by a spring, or a weighted lever, made to press against it.

The spindle, No. 2, has its bobbin placed so as to rest on the haft or warf, and has no copping rail or whirl, the haft moves up and down on the spindle, and is made to turn round along with it in the same manner, as the brass whirl is on No. 1.

The flyer does not unscrew from it, but the whole draws up through the haft when the bobbin is required to be taken of. This spindle is supported at both ends, and is made to rise and fall along with the fly, while the bobbin and haft remain stationary as to vertical motion, by which the thread is laid properly on the bobbin.

The spindle, No. 3, is a compound of No. 1 and No. 2, having the brass whirl of No. 1, and the shifting haft and fixed fly of No. 2; the spindle is also supported at both ends; but neither the spindle nor haft move up and down, and the copping rail, whirl, and bobbin, alone have that motion.

The spindle, No. 4, is in all respects like No. 3, except that the bobbin rests on the copping rail in the usual way.

The bobbins on all the spindles are retarded in the same manner as in No. 1, and this is stated to be very different from the common mode, in which it is asserted that "the uptake of the yarn is occasioned by the yarn itself pulling or dragging round the bobbin," instead of by the retardation of the bobbin. Another point in which they all differ from common spindle, is in their being placed in an inclined position, so that the yarn shall not in its direction form an angle with the rollers; the common spindles are always placed perpendicularly.

Observations.—It would have been as well, if the particular advantages expected to be derived from these spindles had been mentioned; for really they are not quite so obvious as the patentee may suppose; the supporting the spindle at both ends may make it steadier, which may be some advantage for very fine work, as may also the inclining the spindle from the vertical position, but the other contrivances described, do not appear to be of any material benefit. The patentee has by mistake, entirely mistated the principle in which the common bobbin takes up the yarn on vertical spindles, it is by having its motion retarded by *its weight* resting on the copping rail that this is performed; and instead of the "uptake" being caused by "the yarn pulling or dragging round the bobbin" as asserted by the patentee, this dragging round only takes place from the yarn, not being spun sufficiently quickly to cover a round of the bobbin at every revolution of the fly; for if this were the case the bobbin would not turn at all.

The real difference which the patentee's bobbin has from the common one in this respect is, that in it the retardation is occasioned by a spring or weighted lever, which is necessary from the inclined position of the spindle; but in the common bobbin the retardation is caused by its own weight, which the perpendicular position of the spindle allows to press with its full effects on the copping rail.

Mr. John Bywater's *Patent for Improvements in Sails of Ships, and in the working of them. Dated Aug.* 1806. *Rep. of Arts, &c.* No. 58. *New Series.*

Mr. Bywater's improvements relate to reefing sails, without its being necessary to go aloft for that purpose. He describes two

methods of doing this in his specifiation. The first is somewhat similar to that in which linen window-shades are raised or lowered as wanted, by rollers. The sails being in like manner wound on rollers which lie beneath the yards, which are sustained by gudgeons at each end, and by annular supports of iron passing round from the yard beneath the roller, from each of which a sufficient part is removed to admit of small friction rollers being introduced between their extremities, which are placed parallel to the yard, and between which the sail passes upwards to the large rollers: the number of these supports required depends on the length of the yard. In order to turn round the roller from the deck, its ends are made of greater diameter than the other parts, and on them ropes are coiled the reverse way of that which the sail is intended to be wound on the roller, and by hauling these ropes the roller is turned round, in the same way as the little rollers are that sustain the window shades above mentioned.

The other method of reefing sails resembles a process employed also about windows, that by which window curtains are raised. For this method a strong reef-band is sewed to the aft part of the sail, about one-third from the top; to this reef-band a rope is attached similar to the head rope, and to this rope four, or more, reef-lines are fastened at equal intervals from each other, which passing thence upwards to half blocks fixed on the fore part of the yard, from them run along the yard to near the mast, where they go down through blocks to the deck; by these reef-lines the sail is drawn up towards the yard as far as is thought fit: the part of the sail, which is doubled by this operation, is kept tight from flapping back and forwards, by ropes fastened to the leach ropes of the doubled part, which go down to the deck along with the sheets.

Observations.—The second method seems that of the two which would be most likely to meet with the approbation of seamen, as the first seems objectionable on account of the increase of weight it would occasion aloft, by the rollers and other tackle used in it. Perhaps in the second method if horn rings were made fast to the sail, about a foot apart in vertical rows, for the reef-lines to run in, the loose part of the sail would be by them prevented from flapping with less trouble, than by the method proposed by the patentee for this purpose.

Mr. Henry Pratt's *Patent for a Toast Stand, or Improvement on the Stands, called Cats or Dogs. Dated Oct.* 1806.—*Rep. of Arts*, No. 57, *New Series.*

Mr. Pratt's improvement on the stands, called cats, &c. consists in forming their legs so with joints that they can all be

brought to lie in one plane: when opened out, stops attached to the joints prevent the legs from spreading asunder beyond the required angle. These cats are made to serve as toasting stands, by having a toasting fork attached to one of the legs, so contrived that it can be slid down out of the way into a tube formed in the leg for its reception.

Observations.—The improvement on the cats will make them more convenient for laying by when not in use. The plan of the toast fork sliding into the leg of the cat is obviously of no great benefit, but may however be agreeable to many people for its singularity.

Mr. William Nicholson's *Patent, for various Improvements in the Application of Steam to useful Purposes. Dated Nov.* 1806. *Rep. of Arts,* No. 57, *New Series.*

The method in which steam is directed to be applied, in the specification of this patent, is similar to that in which water acts in the ancient instrument called the water blast, and in the same manner will impel forward air, or any other gaseous substance in contact with the perforations of the tube through which it passes.

The principal apparatus described consists of a boiler, from the top of which a horizontal tube passes on to a point perpendicularly over the centre of an air receptacle, where it bends downwards for a small distance, that the current of steam proceeding from it may enter a vertical pipe beneath it, the lower end of which passes a little way underneath water, with which the air receptacle is represented to be about half filled. The upper part of this vertical tube is to be either furnished with lateral apertures above the air receptacle, or has its upper termination gradually contracted to about half of its diameter a little way in, after which it again gradually enlarges to its former dimensions, to give the steam more power on the air; the steam-pipe, of considerably smaller dimensions than the air-tube, entering a very small distance within this termination, forces the air downwards, while more still enters in the interval between the steam-pipe and air-pipe.

The use of the water in the air receptacle is by condensing the steam to separate it from the air, so that the latter may pass on freer from any aqueous mixture than it otherwise would; from the top of the air receptacle an horizontal pipe passes, as represented in the drawings of the specification, to an aperture in the side of a furnace; or it may be otherwise directed, as best suits the purpose for which the blast of air is wanted.

The water in the air receptacle is kept to its proper elevation by

a pipe connected with a reservoir of sufficient height above it to counterbalance the pressure of the enclosed air; another pipe rises from the other side of the air vessel of nearly the same height, furnished with a valve opening outwards, by which the water passes out so as to form a current through the air vessel, in order that it may always be sufficiently cool for the use intended. Three different ways are described for producing this change of the water: first, that already mentioned, by an elevated reservoir filled either by a natural fall or artificially; secondly, by sinking the air vessel about ten feet beneath the surface of the earth; and thirdly, by a reservoir having a pipe of communication with a ball cock in the water of the air vessel, so as always to let in more water as it falls below a certain level.

Methods are mentioned for keeping the steam hot in passing through the air-pipe (one of which is by enclosing the air-pipe with another pipe filled with steam), by which its power on the air remains undiminished by any condensation.

A way is described of applying this operation of steam, in forcing air forward, to aid the water-blast, in which the water is made to pass through the side apertures of the descending pipe from an external vessel, while the air, pressed forward by the steam, passes down a pipe which enters a small way into the upper part of the same descending pipe.

The uses mentioned to which this steam apparatus may be applied are, 1st, for agitating, impregnating, or driving over in distillation water or other fluids; 2d, for oxidating metals for different purposes in various ways; 3d, for blowing furnaces, or forge fires.

Observations.—In order to judge of the degree in which the application of steam, which is the object of this patent, may be of utility, we should compare it with a common steam-engine, applied to force air forward by bellows or air cylinders. It will be evident that the common steam engine has the superiority over this, by all the power that is acquired by its condensing apparatus, which is very considerable; the perfection of Mr. Watt's steam-engine is principally owing to an *improvement* in this part of it; and it is so decidedly superior to all before contrived, that by its aid manymines are now worked to profit, that could not be so by the old engines: now if an *improvement* in the condensing apparatus gives so great an advantage, it is obvious how valuable the apparatus itself must be: therefore for all large works, where great power is required, and the consumption of coals, or daily cost, is a greater object than the first expense of an engine, there can be no doubt that the common steam-engine applied to urge air forward in the usual manner would be much preferable to this apparatus.

There may however be a variety of purposes to which it might

be applied usefully; and this may be the case where a blast of air is wanted for purposes requiring but so small a force that it would not be worth while to go to the expense of a common steam-engine for them, or where the blast will only be wanted occasionally, or after considerable intervals. Many of the chemical purposes the patentee mentions will come under one of these heads.

AGRICULTURE.

A singular Course of Crops, adopted by Mr. BIRCHMORE, *of Flamsted-bury, Herts. Annals of Agriculture,* No. 262.

THIS course of cropping was communicated by Sir John Sebright, of Beachwood, in the same county, and is as follows;—1. turnips dunged; 2. barley; 3. pease; 4. fallow; 5. wheat folded or sooted; 6 clover ashed; 7. clover broke up in June and ploughed thrice; 8. wheat; 9. oats. Sir John Sebright observes, that his own practice is to sow.—1. turnips; 2. barley; 3. clover or vetches, which he eats off; 4. wheat. He thinks Mr. Birchmore's crops of wheat better than his own on land of the same quality, but Mr. Birchmore keeps a larger flock of sheep. These facts are followed by a long catalogue of speculative opinions by Mr. Young, which it is unnecessary to notice.

Observations.—The routine of crops adopted by Mr. Birchmore, whom we know to be a very good farmer, is certainly very rational and well adapted to the light soil which he occupies; it does not, however, deserve the epithet of *singular*, which has been bestowed upon it by the Editor of the Annals; for a similar mode of cropping is very generally adopted in that part of Herts which borders upon the Chiltern hills, though not, perhaps, in exactly the same order, and many farmers do *not* take two crops of wheat with only one intervening crop.

On the Resp or Red-Water, and the Removal of Lice and Ticks in Sheep, containing two Receipts, one used at Holkham, and the other by Mr. OVERMAN.—*Agricult. Mag.* No. 6. *N. S.*

THIS communication, which is anonymous, remarks that the resp, or red-water, has been found to be most prevalent in the

northern parts of the island, in situations within the regions of the hoar frosts, being scarcely known in such districts as are more elevated, and that where sheep are confined in covered folds, during the night, it is seldom or never met with. The writer thinks the best mode of preventing the attacks of this disease is frequently changing the pastures of the sheep towards the latter end of autumn, and the free use of dry food during the night, at such times as they are feeding upon succulent roots or plants of any kind.

The wash used in Norfolk, and adopted at Holkham, for destroying lice and ticks on sheep, is composed of two pounds of tobacco, two pounds and a half of soft soap, and one pound of the white calx of mercury in powder; the whole boiled in eight gallons of water for an hour. This lixivium is sufficient to dress sixty sheep, and is applied by parting the wool down the shoulders and breast, and twice down the sides of the animal, and then pouring it in very carefully. Mr. Overman boils a pound of arsenic and a pound of soft soap for some time in six gallons of water, and then adds to it twenty-six gallons of water more: he dips his lambs in this liquor at the time the flock is clipped, and finds it perfectly destructive of vermin.

Observations.—The remarks on the *cause* of red-water receive confirmation from the circumstance of this disease being scarcely known in France and the Tyrol, where the shepherds always confine their flocks in covered folds during the night to guard them from wolves and other ferocious beasts of prey. The use of hay during part of the twenty-four hours may obviate any evils arising from the too great succulency of other food, and may correct the tendency to this disease: the hint is worthy of recollection. With respect to the receipts for destroying lice and ticks, they are not new; and the ingredients of either will inevitably prove fatal to such vermin, whenever it may be necessary to resort to medicaments to destroy them.

A new Roller for breaking Clods, pulverizing old Turf Fallows, preparing Ground previous to sowing Barley, &c. By Mr. F. B. Harries.—*Agricult. Mag.* No. 6. *New Series,*

This gentleman, who lives near Shiffnal, makes use of a roller consisting of twenty-one cast-iron wheels of twenty-one inches and an half diameter, and three inches asunder, or of fourteen wheels of twenty-three inches diameter and four inches asunder; the wheels are all placed on the same axle-tree, to which is also affixed a larger wheel at each extremity for the purpose of taking it to the field. The writer finds it admirably adapted to strong lands,

and states it to be the invention of a Mr. Grittin, of the Isle, Shropshire.

Observations.—We do not collect from this communication whether the concentric wheels, of which the rollers are composed, turn with or on the axle, though perhaps the fact is not material, as the utility of this roller can only consist in permitting those clods to escape between the wheels, which its weight was unable to break, and this will equally take place in either case. The inventor is said to think it an improvement on the spike roller, on account of the danger of horses being hurt by the spikes in turning; but we conceive he did not recollect that a spike roller ought always to hang in a frame with shafts, and then no such danger could exist.

On Ploughs for all Soils. By an old Farmer.
Agricult. Mag. No. 7, *New Series.*

After remarking that much information on the subject of ploughs has been acquired from the different agricultural societies, he adverts to a ploughing match at Ashridge, the seat of the Earl of Bridgewater. He pronounces it to be his opinion that the old Hertfordshire plough will soon be entirely laid aside, and a lighter one introduced in its stead: that Small's Scotch plough, Lord Somerville's single one, and the Essex, Suffolk, or Norfolk, will fully answer for all ordinary soils and occasions, and that Lord Somerville's two-furrow plough is adapted to make dispatch on middling and light soils, and the Cambridgeshire fen plough has always answered expectation on that kind of soil.

He adds, that the dynanometer is a copy of an instrument invented in France for measuring the force of animal power, and is generally exact: the width of the furrow multiplied by the depth, and divided by the power gives the effect.

Observations.—It is to be regretted, that opinions so dogmatically given ex cathedrâ did not bear the real signature of the writer instead of being signed with initials only. They are true, undoubtedly, in certain circumstances, but are entitled to little attention when supported only by the *opinion* of an anonymous writer, who does not refer to experiments.

On the Staggers in Horses. By Mr. John Wright.
Agricult. Mag. No. 8, *New Series.*

Mr. Wright, who resides at Pickworth, was informed early one morning that a valuable draught horse of his was dying; he arose

and found the horse with the staggers. The animal was too ill for it to be thought he could survive; the farrier resided at a great distance, but yet was sent for; the horse, however, was raving, dashed himself about in convulsive agony, refused food, and was left to his fate. In his struggles however he forced a board off the standing next to the rack, and as the boards were cut off in a slanting direction, the next board then presented a sharp projecting point; on this, as high as he could reach, he had got his jaws over, and could not get off again, and the blood flowed very copiously. The horse was released, and seemed to feel immediate relief, and he soon recovered, owing his recovery, in the opinion of the farrier, to this accident.

Observations.—The unexpected cure, thus accidentally brought about, may furnish a clue for the treatment of that generally fatal disorder, the staggers. The cause of this disease is thought to be too violent labour, and too high keeping to support that labour, and it is perfectly consistent with medical analogy in other cases that relief should be procured by removing the superabundance of blood in the part affected, which in this disorder is the head. Bleeding the animal in the mouth may be safely recommended, as it can never be productive of bad consequences, and may effect a cure.

On the Use and Application of Hay Tea, as a cheap and economical Food for the Support of Store Swine; with Hints on the best Kinds; their Habits and Utility, &c. By Mr. John Saunders, *of Stroud, Gloucestershire.—Agr. Mag.* No. 8. *N. S.*

Premising that to guard against scarcity and to meet the enlarged population of the nation, and its greater prospective increase, are objects which cannot fail to excite care and attention, Mr. Saunders recommends his method of rearing and supporting swine upon hay tea, as a means of multiplying the live stock, and increasing the animal food of the kingdom. He was first led to try the experiment by knowing that it was customary to wean calves in this manner, and from observing that they did equally well as when reared with milk, and found his experiments answer beyond his expectations. He thickened the tea or wash indiscriminately with either grains, bran, or pollard, or any kind of meal, or boiled cabbages, or boiled potatoes, and had the satisfaction of seeing that a single sack of boiled potatoes, when mixed with wash and without any other ingredient, would go as far as five or six sacks given alone. He therefore gradually increased his stock, and found his treatment more and more successful. From accurate experiments and remarks during the consumption of fifteen

hundred hogsheads of the wash made from hay, he maintained his pigs collectively at the very low rate of one penny a head per day, and kept them in excellent store order, and many of them fit for the butcher; and he preferred feeding them only twice a day, for if pigs are fed in this way with regularity, they will lie down contented for the remainder, provided they have a dry and warm place to shelter themselves under. By gradually thickening the wash with meal, he found it form the best introduction to the highest and last stages of fattening both for pork and bacon; he always found that an increased quantity of this cheap and nutritious food regularly administered would satisfy the voracious appetite of this animal, and yield the greatest profit; and observes, that the general adoption of the practice would cause an immense annual saving of corn, and consequently tend to ensure plenty and cheapness, which ought to be the end aimed at in all experiments: and he considers it an important consideration to increase the culture of that valuable root the potatoe, which produces in a given quantity of land more food both for human sustenance and for animals of almost every description, than any other crop whatever.

Mr. Saunders says in a supplement to the letter, that 20lbs. weight of clover or sainfoin hay (which he prefers to common grass) with the addition of thickening ingredients, when well boiled, will make sufficient wash to maintain throughout the day fifty store pigs from three months old to an indefinite age upwards. The Berkshire breed of swine he thinks superior to all others, because they are the hardiest, and feed the best upon the tea, and are careful mothers. A considerable number of tables elucidate and confirm his statement of the expense.

Observations.—This communication of Mr. Saunders contains much valuable and important information. A recollection of the scarcity of corn, which prevailed throughout the kingdom in 1795 and 1800, will recommend to the attention of every friend to his country whatever can tend to alleviate the distresses which accompany such a visitation. Indeed the mode of rearing swine detailed in this paper will always enable the industrious labourer to feed his pigs which is the most valuable of all acquisitions to the family of the poor man. Though the system be new, as applied to swine, yet it has obtained the test of successful experience in rearing calves, and must consequently produce more animal food if applied to swine with equal success. The gentleman, to whom the Agricultural Magazine is indebted for this communication, deserves the thanks of his country; and it is to be wished that he would make known the result of his persevering in the system, which he has so judiciously commenced.

On destroying Couch Grass and preserving Turnips.
Agr. Mag. No. 6, *N. S.*

The writer of this article says, he had at Michaelmas, 1805, four acres of wheat stubble so completely choaked with couch-grass, that he used it as a rough pasture all the winter; in the beginning of the following May he ploughed it with a deep and wide furrow, and suffered it to remain in that state for about ten days, when he rolled it twice in each place with a very heavy roller, and the following day cross ploughed it the same depth as before: in a few days afterwards, he applied the roller again twice in each place, and immediately followed it with a coarse and long tined harrow, on which rode a man, whose business it was to raise and clean the same at the necessary distances: he next day rolled it the third time, and then followed with a finer harrow, and after that with hand-rakes, and then rolled it with a light roller to lay the surface in a fit state for all small seeds to vegetate; he suffered it to remain in this state till Midsummer, when he dunged it well and ploughed it twice, and then drilled turnip seed in eighteen inch rows, covering the seed with a harrow and a light roller, and by these means obtained a larger crop of turnips than he had ever had before. In December, he drew out the alternate rows of the turnips, and then with a plough turned the earth completely over the rows, which remained to preserve them from the frost.

In some notes to this communication much valuable information is contained. It is observed, that the greatest art of clearing land of couch grass, consists in causing its roots to hold together while the roller grinds each clod to powder, in order that the harrow by taking hold of any branch of a family of roots, (as he terms it) may either drag the whole of such family up to the surface, or that such branch may lose its hold of the harrow, for if the smaller branch be torn off, it will produce a new stock; and this effect can only be produced by rolling in dry weather. And as the principal object of rolling is to reduce land to a fine powder, the writer earnestly recommends the experiment of rolling twice in the same place, for he asserts, from strict observation and much practice that the second operation of the roller is much more efficacious in grinding the land than the first, particularly if the middle of the roller returns on the same ground on which the leaving end went forward, not the gaining or gathering end. It is also suggested that the tines of the coarsest harrows are much too near together for going the first time over land which is exceedingly foul, and that couch-grass would be removed much more easily if only about one-fourth of the usual number of teeth were fixed in the harrow, and those of a very great length, so as when loaded

with the weight of a man to go completely to the bottom of the furrow. This writer thinks women, with a little instruction, would hoe turnips much better than men, because it is a business which requires the attention of the eye, and the activity of the hand, more than the labour of the body. Even if the land be dry, he never suffers his own turnips to be hoed while the leaves are wet, for he thinks the dust which hangs to them acts like so much poison, and that to hoe land while it is wet, has more the effect of cement than of pulverization; and he thinks that if no other advantage resulted from drilling turnips, which cannot be obtained from sowing them broad-cast, than the greater facility of hoing, that this alone would be sufficient to recommend the practice.

Observations.—The many sensible remarks contained in the notes to this communication are much more important than the communication itself. They display a rich fund of observation, and would have done credit to the writer, even if he had not assumed a fictitious appellation; and well worthy the attention of every agriculturist, who wishes to direct his own experiments by the guidance derived from the observations of others. The mode recommended of applying the roller is certainly the most effectual yet known, and the observation on harrows is consonant with the experience of the best farmers. It was from a similar idea that Mr. Lester's patent harrow was constructed, but that does not answer equally well as first using a very long toothed coarse harrow, and afterwards a finer one, as recommended in this article.

On the Cultivation of Kelp. By THOS. DUDGEON, *Esq.* *Farmer's Magazine,* No. 29.

THIS gentleman gives an account of the produce of two shores of kelp which were manufactured in 1806 on an estate in Ross-shire, the property of Hugh Innes, Esq. The first shore, (which for distinction is called A) was situated at the confluence of the locks Duish and Long, and contained 4 acres, 1 rood, 1 fall, Scots; the second (which is called D) was situated on the shore of lock Carron, and measured 8 acres, 1 rood, 1 fall, Scots. The shore A produced 7 ton 10 cwt. of kelp (21 cwt. to the ton) but the shore D produced only 5 ton 20 cwt.

As the disproportion between these crops was so very considerable, the writer endeavours to account for it. He states that the crop of kelp-ware on A was cut at three years growth, while that on D was suffered to grow five years, which tends to confirm a generally established opinion among kelp manufacturers that sea-ware is at its prime at three years old for producing kelp, and that every year after it loses substance; it is also evident to the eye that it gets much thinner in the stems and leaves after that time. The un-

favourable state of the weather and the negligent conduct of the kelpers rendered however the attainment of any accurate data impossible; but still the result is deemed sufficient to determine the proper period of growth, and that a longer extension is not productive of advantage. It is also stated that the kinds of ware most frequently manufactured into kelp in Ross-shire are the bell or knotted ware, and the sea-oak; the former of which is esteemed the most productive of kelp. This might be another reason why the shore A produced a greater quantity of kelp than the shore D; it having a greater proportion of the knotted ware.

The best kelpers come from the Isle of Sky, and their hire has, like all other wages, much increased. Lord Seaforth's factor paid a kelper from that island 4*l.* a ton, besides furnishing him with the use of a boat, hooks for cutting the ware and kelping irons, creels and barrows, and lodging. The manner in which the kelpers from the Isle of Sky manufacture the ware is so much more productive than that adopted by the inhabitants of the main land, as to more than compensate for their extravagantly high wages; and it is considered economical to employ them. It appears to the writer, that the average quantity of kelp manufactured from these shores was about one ton and two-thirds of a hundred weight per Scots acre, and he conceives that in general this produce may be safely reckoned on; and it is presumed to be rather below the average produce of kelp from the western highlands and islands of Scotland. He believes the average rent paid to proprietors of kelp shores for several years may amount to about 3*l.* per ton at each cutting. All the cultivation requisite is to place whin or other hard stones, not under the size of the crown of a hat, upon vacant spaces of the shore, of which there are immense tracts on the main land and islands, which might be easily cultivated for the production of kelp, though not one penny is now derived from them. In four years the first crop may be cut, and every third year afterwards: the expense of placing stones at a foot distance each way, the proper distance for the growth of sea-ware for kelp, is about 20*l.* per Scots acre. On these principles this cultivation is recommended to the immediate and serious attention of all proprietors of sea shores in Scotland; and if any doubts should arise as to the propriety of cultivating sea-ware for the purposes of kelp, it is remarked that it would be equally profitable if cultivated for manure only, for the produce would be about 45 tons per acre. "The improvements which may be made in the Highlands at a small expense," observes this writer, "by draining, watering, and trenching, are immense. The inhabitants ought therefore to feel the most lively gratitude for the interest and exertions which Government are taking for the improvement of the country by roads, bridges, and canals; at the same time it seems matter of surprise that Government should overlook the incalculable advantages to be derived from the sea".

Observations.—Though the immediate application of this paper be entirely local, yet the spirit with which it is given to the world deserves much commendation. The attention of agriculturists on the sea coasts is called to a certain and never failing method of obtaining a regular supply of sea-weed for manure, instead of depending on the precarious leavings of the wind and tide, which frequently happen at such times when other unavoidable avocations render it impossible to secure them and apply thom to the land. By the simple process of applying large stones to the naked parts of the beach, the neighbouring farmer may always ensure a regular supply of sea-weed, and may cut his crop at such times as are most suitable to his own convenience.

Recipe for salting Butter, &c.—Farmer's Mag. No. 29:

This communication is made from Dovernside in Bamfshire, where the cows are fed in fine old pastures on the banks of a river. The milk is kept in tin vessels, and the cream taken off after standing twenty-four hours. When the butter is made, if it is to be kept fresh, the writer advises to beat it well from the milk, and then beat it through pickle and make it up; put it in a deep stone dish with spring water over it, and a cover to keep out the air; and then adds the following receipt for salting butter. Wash your butter very clean in a wide deep vessel; beat three drops of saltpetre for each pound, and to half a stone of butter allow half a pound and half an ounce of common salt; cast on your saltpetre first, and then the salt; put them all on before you begin to mix the butter, and then with the clapper mix it through as well as possible, and pick out every lump you can find: let it stand in a stone dish till the next time you churn; do as above, and mix it with the butter in the stone dish; put it all into your kit, and put no pickle on it till the kit is full: observe always to salt the second churning and mix it with the first, before it is put into the kit, when full put strong pickle on it, and a bit of linen to keep out the air." A recommendation is subjoined not to clean the kit, when the salt butter is done with, but to let it stand till within a few days of its being wanted again for use, when it should be well cleaned, and the inside rubbed with salt: if the butter has become rancid, the effect may be romoved by putting in garden mould, which should stand all night in the kit, afterwards it may be cleaned out and used as before.

Observations.—Though this paper is not sanctioned by the signature of the writer, yet we recommend it to the attention of those engaged in the management of the dairy. As rancidity and putrefaction are caused by exposure to the air, the method of covering butter with spring water will always be attended with

beneficial effects even in private families, but care must be taken that the butter has not previously become rancid. The very extensive use of butter in domestic life renders every thing important, which can tend to prevent it from becoming rancid in warm weather, and no means will be found more effectual for that purpose than beating it again through brine after it is brought from the market, and then putting it into a stone pot with spring water over it, as recommended in this communication.

An account of Mr. Rix's *underdrained Meadow.*
Agricult. Mag. No. 6, *N. S.*

This meadow in the occupation of Mr. William Rix, of Clipstone near Fakenham, was a mere bog, and so completely overrun with sedge and rushes, that its utmost annual value did not exceed eight shillings per acre. The occupier, soon after Michaelmas, opened all the ditches and made them very deep, and cut an open drain of some considerable breadth through the middle of the meadow; into this he brought many smaller covered drains with faggots in the usual manner. The mold which had been taken out of the ditches and drains he spread upon the surface, and at the next hay-time he found his meadow perfectly solid, and obtained a very great crop of Hay. The success of this experiment has induced Mr. Rix to underdrain other similar lands in his occupation.

Observations.—Wherever a similar mode is pursued, it will be attended with the same success, and themold plough will frequently produce the effect of bringing the water into the principal drains, and save the expence of fagg ts. The importance of opening and scouring out ditches very deep can never be too frequently inculcated, or too deeply impressed upon agriculturists: if this were duly attended to in small fields, it would in many instances supercede the necessity of underdraining altogether.

Plan for improving the Growth of Tares, by Mr. Tho. Herod.
Com. Bd. Agricult. Vol. v.

Mr. Herod recommends that tares should be sown broad cast in October, from ten to twelve pecks per acre with one peck of wheat, and then ploughed into four furrow ridges. If a one horse double breast plough be run through the ridges in April or May, this will keep them clean, and admit the air to the roots, so that they will continue green and growing till midsummer. He made this communication to the Board of Agriculture, in reply to enquiries issued by order of the Board after the best plan of growing a vegetable, which had been so extremely useful in soiling horses. And having noticed that on the general plan of sowing they began to rot at the bottom soon after they were at a proper age for the stock, in consequence of their containing a great

quantity of moisture; and knowing that they could be given but sparingly to cattle in that state without dry food; to obviate which some people had sown rye, or barley, or oats, among them; he therefore determined to make the experiment of mixing them with wheat, the straw of which becomes hard less early than that of other grain, and is at the same time more palatable to cattle. And since it is well known that tares grow so close together at the tops as to exclude all the external air from the bottoms, and although they continue green at the tops while they receive the air, they continue rotting at the bottom for the want of it, and that the loss to the growers is very great from cattle refusing to eat the decayed part of the plant; he expected that these inconveniences would be obviated by sowing them with wheat, and the result fulfilled his most sanguine expectation. The first experiment was confined to two roods of ground sown in this manner: the tares continued growing with rapidity to nearly five feet in height, *clinging to the wheat;* and though a high wind about Midsummer bent them all down, they were still not laid close to the ground, and appeared like an arch for some yards together up the furrows. These furrows admitted the *light* as well as the *air*, which preserved the plants green as well as kept them growing; for if *air* is admitted, but *light* taken away, they may continue growing, but will lose their colour. These two roods produced more than two horses could eat green, and after Midsummer the remainder was cut, and produced half a load of excellent hay. The experiment was repeated the two following years with equal success, and this gentleman has always found two roods of ground sown in this manner to produce more tares than two horses ever wanted; and he is convinced from his own practice, that tares sown on poor land will improve it, if repeated a few crops. His reason for continuing to sow wheat among tares in preference to any other grain is, that the stems of the wheat are not only strong and hold the tares up, but they are so sweet that stock will eat them with the same avidity as they do the tares, and to as late a time as the tares are proper to cut for soiling.

Observations.—The reasons adduced by this writer for deviating from the common method of cultivating tares would of themselves have been sufficient to have recommended the practice; but the invariable success which attended his experiments place the utility of the mode beyond a doubt. The greatest objection to the sowing this plant—that the bottoms rotted before the tops could be eaten—is completely obviated by adopting the plan of sowing them with wheat; and there can be no doubt but that a crop of this kind cut and made into hay early in the summer would be extremely productive in point of profit, and not at all injurious to the ground, which might be kept free from weeds by the double plough passing up the furrows while the crop was young; and the crop itself, by entirely covering and overshadowing the ground afterwards, will in a great measure prevent their growth afterwards.

On Summer-fallowing. By Mr. Hearn, *of Newport in the Isle of Wight.—Annals of Agriculture, No.* 262.

The intelligent writer of this article draws many conclusions against the practice of summer-fallowing, from the analogy between animal and vegetable life, and supports his conclusions by facts which are generally admitted.

Since the whole animal race must subsist on the produce of the earth, he cannot reconcile it to the laws of nature, that a great part of the earth should with much expense and labour be prevented from yielding a crop of some sort or other through the summer, since it is impossible to obtain one in the winter of any kind whatever. Summer and winter, with respect to plants in this part of the globe, he compares to day and night with its inhabitants; the day the time for labour, the night for rest. Both animals and plants in a living state receive benefit from the sun, but this in a greater degree in a shaded manner; vegetation of every kind is brought to perfection in its seeds under a coating of some kind, as the animal race find shelter from the burning rays of the sun to be the greatest comfort in the summer; and in like manner as the sun's strongest heat will the soonest of any thing turn flesh putrid, so will it with equal certainty wither and decay the vegetable creation.

From reasoning of this nature he concludes it to be a mistaken notion that land requires rest, and thinks that from being exposed to the free action of the sun it is subject to the greatest imaginable injury; for it is admitted that a dunghill, from this circumstance, becomes robbed of that nutriment which is so essentially necessary to promote vegetation; and chalk is thereby found so perfectly hardened as to lose its chief virtue; and he cannot therefore reconcile it to reason, when these great supporters of land, the one its food, the other its medicine, are intermixed with it, and from frequent ploughings exposed to the searching power of the sun, that a real benefit should arise to the land.

As to land wearing out, as it is termed, he thinks it an opinion which ought and must be exploded: for Providence certainly could not have laboured so defectively: should the world be thus situated, and still endure, yet future generations would gradually but inevitably sink under the cravings of hunger, and the earth be again as slenderly inhabited as after the deluge.

He observes that meadows continue to produce the same crop year after year successively, and that no perennial trees or plants wither and decay because the earth is exhausted of that kind of vegetable matter which is necessary for their support. Coppices covered with timber for centuries together, and underwood though not cut down oftener than once in fourteen years, afford a proof

that land will continue to produce the same kind of vegetable. Mr. Hearn attributes the cause of one kind of grain not succeeding in repeated succession, to the putrid matter arising from the rotting of the root of the former crop, bringing about a similar putrefaction in the roots of the growing crops, in the same manner as inoculation with the putrid matter of a dead body producing certain death in the human species. The mode in which woods are supplied with nourishment after exhaustion he attributes not only to the manure arising from the decayed leaves, but also to the circumstance of shade, which he considers most beneficial to land, and remarks, as an additional proof, the certainty of a luxuriant crop of wheat after such a full crop of peas as shade the ground entirely, by being matted on its surface. He thinks his opinions respecting the fatal effects of the putrid matter generated by the decaying roots of vegetables receives much confirmation from the greater difficulty there is in producing a succession of deep-rooted plants over those whose roots run near the surface: and on this principle he accounts for the difficulty experienced in obtaining a second crop of clover on the same land at a less interval than six years; for the roots of clover run very deep in the ground, and take four or five years before they are destroyed by putrefaction. As this circumstance has been almost generally remarked, but has not been before accounted for, we extract the paragraph which contains the observations. "Clover," says he, "appears overnice among the vegetable tribe, and, from the solidity and depth of its root, is for a long time detrimental to its own kind of vegetation, but not to that of any other; of course the extreme part, though descending deeper in the earth than any usually applied instrument of husbandry can touch, may naturally be supposed to endure for a long time. Hence it is easy to account why young plants early succeeding the old, should stand in the earth and look healthy all the winter, and after vegetating in the spring dwindle and die away. It proceeds from the roots of the new, so increasing in length, as to be affected from the matter retained in such parts of the preceding, not sufficiently decomposed to become a manure, but remaining still in a poisonous state; for which cause such kind of culture will not effectually answer oftener than once in six years."

He admits that some temporary good appears to arise from fallowing, such as the destruction of couch-grass and other noxious weeds but thinks this might be accomplished without losing a crop; and observes that the thistle roots too deep to be eradicated by this operation, and that the poppy and the yarrow, which are peculiarly destructive to crops, for they feed on the acid of the soil, are positively increased by fallowing. Burning of land, in order to accomplish the temporary destruction of a worm or a weed, he compares to burning and destroying a good constitution in order to satiate a man's unquenchable thirst with spirituous liquors.

Observations.—The reasoning by analogy from the animal to the vegetable kingdom, which Mr. Hearn has adopted in this paper, dis-

plays a strong mind and a sound understanding. The conclusions are certainly philosophical, and receive much confirmation from the facts which are adduced. The theory of the fatality of putrid vegetable matter to its own species, is an idea which deserves much attention, and undoubtedly afford a solution of many occurrences in agriculture which have hitherto eluded the penetration of the most intelligent farmers in the kingdom. It is deserving of remark, that where the same vegetable flourishes for a long series of years, it is a perennial plant, and the putrefaction of its roots from ceasing to live, does not take place; and that no succession of those crops can be obtained, which require to be sown immediately after the former crop has been removed from the ground, or indeed before the passing of a winter. Thus barley succeeds after barley much better than wheat after wheat; and probably from the circumstance of the interval between the harvest of the preceding and the seed-time of the succeeding crop in barley, being sufficient for the complete putrefaction of the root, which cannot obtain in a repetition of wheat crops. This principle too, applied to clover, affords a satisfactory explanation of a circumstance, which is of the first importance to agriculturists; since clover is now so universally resorted to for an artificial crop of green food. The facts mentioned of the effect of shade are also highly deserving of attention; they may tend to introduce a succession of crops more beneficial to the husbandman than any which have been yet adopted; and the advice to copy nature is very rational, but must be received with some exceptions. Though a regular system of fallow may be bad, yet fallow may be sometimes unavoidable. Mr. Hearn's reasons against it, as a system, are well worthy the attention of those who hold an opposite opinion.

Some Particulars respecting the Husbandry of East Kent, and the Mode of Cropping adopted there. By a Man of Kent.—Farmer's Mag. No. 29.

The most common rotation of crops adopted in East Kent is stated to be, 1. Barley; 2. Beans; 3. Wheat. The wheat *gratten* (a provincial term for stubble) is ploughed directly after the wheat side is finished, if the weather is dry, and cross-ploughed as soon as possible in the spring; again ploughed two or three times, according to the cleanness of the land. In April barley is drilled in rows from eight to ten inches apart, at the rate of 2½ or 3 bushels per acre: the crop is hand-hoed, and weeded. Next winter a good dressing of manure is carted and spread upon the barley stubble, and the land ploughed: beans are drilled 18 or 20 inches apart, about 4 bushels to the acre; when they are up, the land is harrowed across the rows, and horse- and hand-hoed, and

kept completely clean. When the beans are cut, and often before they are carried off the ground, the land is broad-shared, or *spuddled*, and the rubbish either burned or carried off till perfectly clean; it is then ploughed and sown with wheat, and preserved as clean as possible. This is given as the old Kentish *Round Tilth*, and is said to be very productive on good land. When clover is wanted, it is sown with the barley, and is again broken up with the bean-gratten for wheat. In addition to this description of what is called the *round tilth of Kent*, the writer subjoins an account of the mode of farming pursued by himself: his course is, 1. Potatoes; 2. Barley; 3. Clover; 4. Wheat. After the wheat season, the wheat-gratten is ploughed, and in spring long dung is carted out and spread upon the land: in April or May potatoes are planted by opening balks with a plough, and the seed is covered by splitting the balks. When the potatoes appear the land is dressed down fine, and hand-hoeing and skimming are given through the summer, and in August they are earthed up with a double-mold-board plough: in November the crop is ploughed up by the same plough opening every other furrow, and gathered by women. The land is then wrought with heavy loaded harrows, and picked clean, and left till spring, when it is ploughed and drilled with barley. The barley when up is hand-hoed and sown with clover, which, after the barley is carted off, is either fed with sheep till June, and then seeded, or mown for hay. In November the land is ploughed and drilled with wheat 3 bushels to the acre in rows from seven to nine inches asunder, and kept clean by hand-hoeing and hand-weeding during the summer. The following account of expenses and profits is added:

	Expenses.			Produce.			Profit per Acre.			Profit on 20 Acres.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
Potatoes	16	8	6	24	0	0	7	11	6	151	10	0
Barley	5	5	0	13	0	0	7	15	0	155	0	0
Clover	5	1	0	12	0	0	6	19	0	139	0	0
Wheat	6	17	6	14	14	0	8	6	6	166	10	0
									Annual profit on 80 acres	£612	0	0

Observations.—The rotation usually observed in East Kent has certainly been improved upon, by the writer of this paper, in the introduction of potatoes between the two crops of white grain, wheat and barley. It appears to us, however, that beans might be adopted with equal advantage to the farmer in point of profit, and they certainly would prepare the land equally well, if not better, for the succeeding crop of barley. The conductor of the Farmer's Magazine has remarked in a note to this communication, that success must be a singular felicity, where no more than three ploughings are given in four years, and we quite agree with him in the observation; but we wish our readers to bear in mind that the soil of East Kent is remarkably light and porous, and that when the land is once broken up by the plough, the harrow is in

all cases adopted for further ameliorating the soil, and that the use of this implement is not spared in this detail of husbandry. The profits appear very great; but few districts of country are equally suited to this mode of husbandry as the county of Kent, and therefore the same course of cropping must not be expected to be adopted elsewhere with the same success.

On the Management of thin Soils incumbent on a retentive Bottom. By RUSTICUS.—*Farmer's Magazine, No. 29.*

IT is observed that the soils under consideration have a great stomach for dung, while they yield but a small quantity of materials from which that article can be manufactured, for which reason it is indispensably necessary that they should be sparingly cropped to prevent exhaustion, and rather by the aid of pasture grass be kept in a fresh and recruiting state, so as to carry corn crops when broke up without much assistance from dung. The following rotation is recommended as best calculated to promote the improvement of the soil, and the interest of the occupier:—1, Summer fallow, on which dung is to be laid as far as it can be procured; 2, Wheat, rye, or oats, and grass seeds to be sown with the crop after fallow, whatever grain is put upon it; 3, Grass, a small part to be cut and the remainder pastured; 4 and 5, Pasture grass; 6, Broke up for oats, and the land to be fallowed in the seventh year, which would be the first of a second rotation. The writer remarks that the small quantity of corn produced in this way on any given breadth of soil may be considered an objection, but he is of opinion that the breeding and feeding of lambs on such soils is the most advantageous mode of stocking them, because it is only in the first part of the season that grass is to be obtained from them, at the end of which period the lambs are sold, leaving a sufficient maintenance for their mothers; but in this way it is only the lamb and the fleece of the ewe that can be calculated on as profit: two ewes per acre are said to be a sufficient stock for such land.

Observations.—The only new matter contained in this paper, is the suggestion that the most advantageous mode of cultivating light soils is to keep them much in grass for the purpose of breeding lambs. This opinion meets with our perfect concurrence; for we are fully convinced that sheep are the only profitable stock which can be kept on lands of this description.

On Horses and Oxen. By Mr. R. EMERSON.

Communications to the Board of Agriculture, Vol. V.

THIS paper is the reply to a letter circulated by the Board of Agriculture, containing the mode of experiment required for as-

certaining the comparison between horses and oxen in relation to their work, and details the writer's reasons for declining the experiment according to the proposed mode, as well as some general observations on the subject. He states, that if he were to comply with feeding the oxen with hay and corn, the same as horses, during the winter, he should incur an additional and unnecessary expense, for he is convinced that oxen are capable of doing as much labour with hay only, as horses are with hay and corn;—and that if he were to confine his horses to hay only, and oblige them to do their usual work, he should sustain a considerable loss in the value of the horses themselves, and is certain they would not be able to continue performing their work: he observes, therefore, that he wants neither time nor further experience to enable him to give a decisive opinion in favour of oxen. He thinks the cause why oxen endure their work better than horses, to be, that the ox in his work chews his cud, and consequently receives a supply of nutriment, which continues to refresh him all the day; and when the work of the day is finished, he fills himself hastily, and lies down to rest and chews his cud: in the morning early he again fills himself, which furnishes him with support during his day's work: and when the ploughman takes a little bread in the middle of the day, even in that short space oxen lie down and rest: whereas horses continue all day in a standing posture, and require a great length of time before they can satisfy themselves with food. Besides, the latter is wholly employed, both before and after their work, in giving them their food in small quantities, in order to induce them to eat quickly as much as possible, that they may have more time to take their rest, that they should be able to perform their work; but the ox-man has only to fodder his beasts once before and once after their work, and is then at liberty for any other employment. The shoeing of horses too and other attendant expenses are considerable, while the ox requires no iron on his feet, but is much better without. If oxen were harnessed at two years old, the hoof would become hardened, and preclude the necessity of shoeing.

Observations.—Of the many papers which we have recently had occasion to notice respecting the comparative merits of horses and oxen in husbandry, this contains the most conclusive arguments of any of them in favour of oxen. At the present high price of labour, saving the *time* of the servant employed is an important consideration, independent of every other, and which we do not recollect to have seen noticed in any preceding publication on the subject.

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RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL AND AGRICULTURAL

DISCOVERIES.

No. IX.] *April, May, June.* [1807.

AGRICULTURE.

On the Direction of the Radicle and Germen during the Vegetation of Seeds. By THO. AND. KNIGHT, *Esq. F. R. S. In a Letter to the Right Hon. Sir* JOSEPH BANKS, *K. B. P. R. S.* —*Philos. Trans.* 1806.

MR. KNIGHT commences his Letter by remarking, that it can scarcely have escaped the notice of the most inattentive observer of vegetation, that in whatever position a seed is placed to germinate, its radicle invariably makes an effort to descend towards the centre of the earth, while the elongated germen takes a precisely opposite direction; and that it had been proved by Du Hamel, that if a seed, during its germination, be frequently inverted, the points both of the radicle and germen will return to the first direction. Some naturalists having supposed these opposite effects to be produced by gravitation, yet as their hypothesis did not appear to him to have been strengthened by any facts, they were able to adduce in support of it, nor much weakened by the arguments of their opponents; and as the phenomena observable during the conversion of a seed into a plant, are the most interesting that occur in vegetation, he commenced the experiments which are the subject of the letter.

Conceiving that if gravitation were the cause of the descent of the radicle, and of the ascent of the germen, it must act either by its immediate influence on the vegetable fibres and vessels during their formation, or on the motion and consequent distribution of the true sap afforded by the cotyledons: and as gravitation would

produce these effects only, while the seed remained at rest, and in the same position relative to the attraction of the earth, he imagined that its operation would become suspended by a constant and rapid change of the position of the germinating seed, and that it might be counteracted by the agency of centrifugal force.

He therefore constructed a small wheel, similar to that of a corn-mill, to be turned by a rill, which flowed through the garden, and on the same axis fixed another wheel of eleven inches diameter, to the circumference of which were bound numerous seeds of the garden bean, which had been previously soaked in water, to produce their greatest degree of expansion. The radicles of these seeds were made to point in almost every possible direction, and the whole was inclosed in a box, with a wire grating to prevent the ingress of any body capable of impeding the motion of the wheels, which, when the water was admitted, performed something more than 150 revolutions in a minute. In a few days the seeds began to germinate, and the radicles, in whatever direction they were protruded from the position of the seed, turned their points outwards from the circumference of the wheel, and in their subsequent growth receded nearly at right angles from its axis: the germens on the contrary took the opposite direction, and in a few days their points all met in the centre of the wheel. Three of these plants were suffered to remain on the wheel, and were secured to the spokes to prevent their being shaken off by its motion: the stems of these plants soon extended beyond the centre of the wheel; but the same cause which first occasioned them to approach its axis still operating, their points returned and met again at its centre. The position of the wheel being in this experiment vertical, the radicle and germen of every seed occupied during a minute's portion of time in each revolution, precisely the same position they would have assumed had the seeds vegetated at rest; and as gravitation and centrifugal force also acted in lines parallel with the vertical motion and surface of the wheel, Mr. Knight thought some slight objections might be made against the conclusions he was inclined to draw.

He therefore added to this machinery a horizontal wheel, to which, by means of multiplying wheels of different powers, he was enabled to give many different degrees of velocity. Round the circumference of this horizontal wheel, whose diameter was also eleven inches, seeds of the beans were bound as in the former experiment, and it was then made to perform 250 revolutions in a minute. By the rapid motion of the water-wheel, much water was thrown upwards on the horizontal wheel, part of which supplied the seeds on it with moisture, and the remainder was dispersed in a kind of shower over the seeds on the vertical wheel. Every seed on the horizontal wheel, though moving with great rapidity, necessarily retained the same position relative to the at-

traction of the earth; and therefore the operation of gravitation could not be suspended, though it might be counteracted in a very considerable degree by centrifugal force; and the difference which had been anticipated between rapid vertical and horizontal motion soon became apparent. The radicles pointed downwards about ten degrees below, and the germens upwards as many degrees above the horizontal line of the wheel's motion; the centrifugal force having made both to deviate 80 degrees from the perpendicular direction each would have taken, had it vegetated at rest. As the rapidity of the wheel was gradually diminished, the germens grew more upright, and the radicles descended more perpendicularly; and when it did not perform more than 80 revolutions in a minute, the radicle pointed about 45 degrees below, and the germen as much above the horizontal line, the one always receding from, and the other approaching to the axis of the wheel.

Mr. Knight does not however assert that the velocity of 250 or of 80 revolutions in a minute will give *precisely*, the degrees of depression which he has mentioned as his machinery was not made with all the accuracy of a professed mechanic, but he conceives it to be fully proved that the radicles of germinating seeds are made to descend, and their germens to ascend by some external cause, and not by any power inherent in vegetable life; and he sees little reason to doubt that gravitation is the principle, if not the only agent employed in this case by nature. He argues that as the radicle of a germinating seed, (as many naturalists have observed) is increased in length only by new parts successively added to its apex or point, and not at all by general extension of parts already formed; so the new matter which is thus successively added, unquestionably descends in a fluid state from the cotyledons: On this fluid, and on the vegetable fibres and vessels whilst soft and flexible, and whilst the matter which composes them is changing from a fluid to a solid state, he conceives gravitation would operate sufficiently to give an inclination downwards to the point of the radicle:—and as the radicle has been proved by these experiments to be obedient to centrifugal force, it can scarcely be contended that its direction would remain uninfluenced by gravitation. As the radicle increases in length by parts successively added to its point, the germen, on the contrary, elongates by a general extension of its parts previously formed, and its vessels and fibres appear to extend themselves in proportion to the quantity of nutriment they receive. And if the motion and consequent distribution of the true sap be influenced by gravitation, it follows, that whenever the germen deviates from a perpendicular direction, the sap must accumulate on its under side; and in uniformity to this conclusion, Mr. Knight has found, in a variety of experiments on the horse-chesnut, the bean, and other plants, when vegetating at rest, that the vessels and fibres on the under side of the germen invariably elongate much more rapidly than those on its upper side;

and thence it follows that the point of the germen must always turn upwards. And it has been proved that a similar increase of growth takes place when the sap is impelled there by centrifugal force, as it is attracted by gravitation to its under side, when the seed germinates at rest. The increased elongation of the fibres and vessels of the under side does not appear him to be confined to the germens, nor even to the annual shoots of trees, but to produce also the most extensive effects in the subsequent growth of their trunks and branches; and though the immediate effect of gravitation would occasion the depression of every branch, which extends horizontally from the trunk of the tree, and, when a young tree inclines on either side, to increase that inclination; yet as it attracts the sap to the under side at the same time, the sap occasions an increased longitudinal extension of the new wood on that side; and thus the depression of the lateral branch is prevented, and it is even enabled to raise itself above its natural level, when the branches above are removed, and a young bent tree becomes by the same means more upright: nature, as usual, executing the most important operations by the most simple means. —Mr. Knight asserts that he could adduce many more facts in support of these deductions, but conceives those above stated to be sufficiently conclusive.

It having been objected by Du Hamel that gravitation could have little influence on the direction of the germen, were it in the first instance protruded, or were it subsequently inverted, and made to point perpendicularly downwards, Mr. Knight relates some experiments on the bean, and the horse-chesnut, which he made to enable him to answer this objection: the extremity of the radicle of the bean, when made to point perpendicularly upwards, generally formed a considerable curvature in three or four hours, when the weather was warm; the germen was more sluggish, but it never failed to change its direction in twenty-four hours; and all his efforts to make it grow downwards by changing its position proved abortive. To answer another, and apparently a more weighty objection, which arises from the facts that few branches of trees rise perpendicularly upwards, and that their roots always spread horizontally, he observes, that the luxuriant shoots of trees, which abound in sap, in whatever direction they are first protruded, almost uniformly turn upwards, and endeavour to acquire a perpendicular direction, and to this their points will immediately turn, if they are bent downwards in the progress of their growth, their curvature upwards being occasioned by an increased extension of the fibres and vessels of their under sides, as in the elongated germens of seeds; while the more feeble shoots of the same trees will at the same time grow in almost every direction, because their fibres being more dry, and their vessels less amply supplied with sap, they are less affected by gravitation. He remarks that the same circumstances occur in the radicle, which

tapers rapidly as it descends into the earth, from being compressed by the solidity of the mould into which it penetrates; the sap continues to descend from the cotylédons and leaves, and occasions a continued increase of the growth of the upper part of the radicle; the sap therefore, is obstructed in its perpendicular descent, and numerous lateral branches are generated, into which a portion of the descending sap enters; and the substance of these roots, like those of the slender horizontal branches, is less succulent than that of the radicle first emitted, and they are consequently less obedient to gravitation; and as they meet with less resistance from the superficial soil, than from that beneath it, they extend horizontally in every direction.

As trees possess the power of turning the upper surfaces of their leaves, and the points of their shoots to the light, and their tendrils in any direction to attach themselves to contiguous objects, Mr. Knight suspected that their lateral roots, may, in like manner, be directed to any soil in their vicinity, which is best calculated to nourish the plant, to which they belong; he had noticed that the roots of aquatic plants usually point towards the water, while those species, which delight in a dry soil, were found to take an opposite direction, but the result of some experiments which he made, were not favourable to this hypothesis; they were not however, sufficiently varied, to enable him to decide the question.

Observations.—We have seldom met with a paper more interesting to the naturalist, the agriculturist, and the botanist, than this letter of Mr. Knight. It must afford no small degree of satisfaction to all of these to have it proved by experiment, that nature carries on the occult and heretofore unaccounted-for, principles of vegetation, by one of those plain and simple laws, which regulate other parts of the creation. The experiments described in the letter, could have only been suggested by an ingenious mind, and matured by the most patient attention. But both these qualifications are admirably combined in this writer, who has before enriched the Philosophical Transactions, with many valuable communications, relative to the vegetable kingdom. His acquaintance with elegant literature, enables him to acquire a knowledge of the proceedings of learned men, in the different kingdoms of Europe, and his love of truth and science, induces him either to confirm their opinions by experiments conducted by himself; or to pursue those experiments till he can fully support a different theory. To this talent of research the British public are indebted for a knowledge of the causes of a process in the germination of vegetables, which all have observed, but no one before has satisfactorily accounted for. His accurate investigations, and extensive researches, into vegetable nature, entitle him to the high estimation of Britain, and of Europe.

On the inverted Action of the Alburnous Vessels of Trees. By T. A. KNIGHT, *Esq. F.R.S. in a Letter to the Rt. Hon. Sir* JOSEPH BANKS, *K.B. P.R.S.—Philos. Trans.* 1806.

MR. KNIGHT having endeavoured to prove in some previous letters, published in the transactions of the Royal Society, for the five preceding years, that the fluid by which the various parts, that are annually added to trees and herbaceous plants, whose organization is similar to that of trees, are generated, had previously circulated through their leaves, either in the same, or preceding season, and subsequently descended through their bark; informs Sir Joseph Banks, that he had repeated every experiment, from which he expected an unfavourable result, without being in possession of a single fact, which was not perfectly consistent with the theory he had advanced. Hales and Du Hamel, however, having stated a circumstance which appeared strongly to militate against his hypothesis, and which had probably induced Hales to deny altogether the existence of circulation in plants, and Du Hamel to speak less decisively in favour of it, than he would otherwise have done, Mr. Knight adduces many cogent arguments in support of his own opinion, and gives an account of the following experiments, which he conceives to tend to the confirmation of it.

As soon as the leaves of the oak were nearly full grown in the spring, he selected in several instances, two poles of the same age, and springing from the same roots, in a coppice which had been felled about six years before, and making two circular incisions at the distance of three inches from each other, through the bark of one of the poles on each stool, he destroyed the bark between the incisions, and thus cut off the communication between the leaves, and the lower parts of the stem and roots, through the bark. Much growth took place above the space from which the bark had been taken off, and very little below it. When he examined the state of the alburnum, in the succeeding winter, he found it had not succeeded according to his hopes; for a portion of the alburnum in almost every instance, was lifeless, and almost dry to a considerable distance below the space, from which the bark had been removed, but in one instance, the whole of it was perfectly alive, and in this the specific gravity of the wood, above the decorticated space, weighed, as soon as it was detached from the root, 1114, and of the wood below it, only 1111; while the wood of the unmutilated pole at the same distance from the ground, was found to be 1112.

He saw very considerable difficulty in obtaining any very satisfactory, or decisive facts from experiments in this case, on plants,

in which the same roots and stems collect and convey the sap during the spring and summer, and retain within themselves that which is, during the autumn and winter, reserved to form new organs of assimilation in the succeeding spring. In the tuberous rooted plants, the roots and stems which collect and convey the sap in one season, and those in which it is deposited and reserved for the succeeding season, are perfectly distinct organs; and from one of these, the potatoe, he obtained more interesting and decisive results. His principal object was to prove, that a fluid descends from the leaves and stems to form the tuberous roots of this plant, and that this fluid will in part escape down the alburnous substance of the stem, when the continuity of the cortical vessels is interrupted; he had also other objects in contemplation. Every gardener knows that early varieties of the potatoe do not afford either blossoms or seed; and he attributed this peculiarity to privation of nutriment, owing to the tubers being formed præternaturally early, and thence drawing off that portion of the true sap, which in the ordinary course of nature is employed in the formation and nutrition of blossoms and seeds. He therefore planted in the last spring some cuttings of a very early variety of the potatoe, which had never been known to blossom, in garden-pots, having heaped the mould as high as he could above the level of the pot, and planted the portion of the root nearly at the top of it. When the plants had grown sufficiently high, they were secured to strong sticks fixed in the pots; and the mould was then washed away from the base of their stems by a strong current of water. Each plant was more suspended in air, and had no communication with the soil in the pots, except by its fibrous roots; and as these are perfectly distinct organs from the runners, which generate and feed the tuberous roots, he could readily prevent the formation of them. Efforts were soon made by every plant to generate runners and tuberous roots; but he destroyed them as soon as they appeared. Upon this an increased luxuriance of growth became visible in every plant, numerous blossoms were emitted and every blossom afforded fruit. Conceiving that only a small part of the sap would be expended in the production of blossoms and fruit, he was anxious to know what use nature would make of the remainder; for which purpose he took effectual means to prevent the formation of tubers on any part of the plants, except the extremities of the natural branches. After an ineffectual struggle of a few weeks, the plants became perfectly obedient to his wishes, and formed their tubers at the places assigned them. Many of the joints of the plants became enlarged and turgid; and Mr. Knight believed that if he had totally prevented the formation of regular tubers, these joints would have acquired an organization capable of retaining life, and of affording plants in the succeeding spring. In some of the plants he detached many of their lateral branches from the principal stems, letting them remain suspended by such a portion only of alburnous and

cortical fibres and vessels, as were sufficient to preserve life, and he had the pleasure of seeing that, even in this position, the sap remained and formed small tubers at the base of the leaves of the depending branches, instead of returning down the principal stem into the ground.

The learned writer, conceives these facts sufficient to prove that the fluid from which the tuberous root of the potatoe, when growing beneath the soil, derives its component matter, exists previously either in the stems, or leaves; and that it subsequently descends into the earth: and as the cortical vessels during every period of the growth of the tuber, are filled with the true sap of the plant, and as these vessels extend into the runners, which carry nutriment to the tuber, and in other instances, evidently convey the true sap downwards, there appears little reason to doubt that the tuber is naturally fed through these vessels. To establish this conclusion, he removed a small portion of bark, extending round the stems of several plants of the potatoe, close to the surface of the ground; the plants continued in health for some time, but the tubers did not attain their natural size, partly owing to the declining health of the plant, and partly to the stagnation of a portion of the true sap, above the decorticated part. He observes, if the inverted action of the alburnous vessels be admitted, it is not difficult to explain the cause, why some degree of growth takes place below such decorticated spaces on the stems of trees, and why a small portion of bark and wood is generated on the lower lip of the wound; the very circumstances which Hales and Du Hamel have described. He concludes his letter, by remarking that the facts, which it contains, are not so worthy of notice in themselves, as that they tend to establish an hypothesis contrary to the opinion of Hales and Du Hamel; and yet producing the very appearances, from which they drew an opposite conclusion.

Observations.—These experiments shew beyond a doubt that the sap descends through the alburnous vessels of the potatoe, and affords a strong presumption that this process of nature is not confined to succulent annual plants, but is also common to trees and shrubs; though of course its effects will be less powerful in plants of perennial duration. The experiments were made with the accuracy, and communicated with the liberality which distinguish this gentleman, and sufficiently explain to the gardener, the causes why different varieties of the same species of vegetable, exhibit different appearances. It also tends to justify and elucidate a usual effort of nature, who invariably bestows one means of support, with a superabundance proportionate to the defect of another, and that not in the vegetable kingdom alone, but equally so in every part of the creation. Hales and Du Hamel drew a different conclusion from Mr. Knight, because they reasoned from the effect only, without pursuing an investigation into the causes of the appearance.

The Cause of Curl in Potatoes, and a Cure for that Disease.—Farmer's Magazine, No. 30.

This communication is made by Mr. James Inglis, of Parkholm, and is stated to be the result of long observation and experience in the cultivation of the potatoe, by Robert Wellwood, Esq. of Gravock. That gentleman had made it his study to find out the cause of curl in Potatoes, and for that purpose, whenever he found a diseased plant, he took it up, and always found the young stem or shoot stripped of its skin or bark. He observed this appearance several times, before he found out the cause; but by taking caution, and being more accurate in his researches, he discovered a small insect, of the worm kind adhering to the stem, and feeding upon it. From this circumstance, it seemed evident that a certain proportion of the sap destined to nourish the plant, is lost by the incision made by the insect. It is a well-known fact, that young plants, as well as young animals, must have a proper supply of food, otherwise their strength and health will be in proportion to the nourishment they received when young. At the end of the year, some of the produce of the diseased plants were laid up for seed, and planted in the spring, and they turned out as healthy and sound as any plant in the field; which he considers to be a direct proof that the disease is local, and not hereditary, as has been generally believed. He thinks that if the cuttings were steeped in lime-water, or in water impregnated with tobacco, or soot, no vermin would attack the plant when young, and the disease might be prevented.

Observations.—The many papers that have been published on the culture of that useful plant, the potatoe, and which have been noticed in the preceding numbers of this work, seem at last to have produced a rational account of the cause of a disease most fatal to its prosperity. Since we know that the young plants of the turnip, cabbage, &c. and many other of the succulent kind, afford most delicious food to insects, it is extremely probable that they may find much nourishment from the saccharine juice of the young potatoe. As the effect of the curl in potatoes, is the destruction of the stalk in a manner similar to the blight in wheat, it is as reasonable to suppose that an insect may be the cause of the one as well as the other. If the writer of this article be correct in his conjectures, as to the cause of the disease, there can be little doubt but that the preventive, which he recommends, will be found effectual.

Account of an accidental Improvement in Husbandry.—Farmer's Magazine, No. 30.

The writer of this article had sown with oats, a field of about four acres, meaning to lay it down in a few days with grass-seeds for pasturing, but the weather was so dry, that he delayed sowing the seeds, till there was some appearance of rain, which did not occur till the corn was five inches high. Having then cast the seeds into a part of it, his roller broke as he began to work with it, upon which he yoked a couple of harrows, to cover the seeds at the expense of the corn, a great deal of which was torn up by the roots. The rest of the field was suffered to remain as it was. In two or three weeks, the part harrowed, though formerly the worst of the field, could be distinguished as a distance by its rankness and deep green hue, and in harvest, produced by far the better crop. From this circumstance, he is induced to think that harrowing may prove an easy and valuable kind of hoeing in the broad cast husbandry.

Observations.—The advantage resulting from harrowing a crop of corn, is not a new discovery in the broad-cast husbandry. It has been found beneficial, and long practised by many farmers. It loosens the earth about the roots of the corn, and at the same time that it destroys the weeds, it promotes the growth of the crop. Though a few of the blades of the corn may be torn up by this process, yet the remainder make ample amends for the loss by the increased quantity of their produce. This operation is found particularly beneficial on adhesive soils, when they have become hardened from a considerable quantity of rain, and in such a case may be advantageously applied to all crops, which are not of the leguminous kind.

Hints, which may be useful when Trees are to be Planted.—Farmer's Magazine, No. 30.

The writer, being on a visit in the highlands of Perthshire, had occasion to observe a very remarkable difference in the qualities of *ash* and *plane* timber, from which he formed a decided opinion of the superior value of the latter. In an avenue, consisting of both kinds, then cut down, the ash trees were uniformly found to be completely rotten and useless, and the planes to be perfectly sound, and very fine timber. The soil in which they grew, was equally favourable to both, being a sandy loam on a gravelly sub-soil, and in a southern exposure. The age of the trees was from eighty to

one hundred years, and they were known to have been all planted at the same time. This fact, in his opinion, demonstrates so very superior a degree of durability in the plane, over the ash, as should render it universally, or at least, more generally adopted in situations, where trees are planted to decorate a lawn, or in any other way intended for *fixtures*.

Observations.—The observations and recommendation of this writer, are well deserving the attention of those who are about to make plantations. The plane tree is equal to the ash in rapidity of growth, and far superior in beauty and value. There are also few uses, to which the ash is applied, to which the plane is not equally applicable. The plane has not met with an attention proportioned to its merit, and deserves not only to be planted for ornament, but to be cultivated for timber.

On Long Fresh Dung. By Mr. Herod, *of North Creak, in Norfolk.—Annals of Agriculture,* No. 263.

Mr. Herod observes that the principal part of the land in Norfolk, is manured for turnips, and remarks that care is generally taken, that the dung be laid on as rotten as possible, from an idea that it will not bury when laid on long, but keep the ground hollow, and let in the drought. This seems plausible, and may take place, if the lands are manured in the summer months; but this writer says, that the manuring should take place in the winter, and the muck be rolled with a heavy roller, as soon as spread, and ploughed in directly with a proper whelming plough immediately before it gets dry, and then rolled again. If thus turned in wet, it will, even on light soils, rot in due time, and the lands will have imbibed all its goodness for the turnip crop. In confirmation of this opinion, he gives some account of his own practice. In 1803, he selected a four acre field of a light soil which was then cropped with barley, but so ordinary and full of weeds, that the crop was not worth threshing. It was ploughed immediately after the corn was off; and in November, twelve loads of fresh long dung, were laid in per acre, rolled, ploughed-in, and rolled again; then one hundred loads of marl, per acre, which, after laying the winter, was well harrowed in the spring. In May, he gave it a thin ploughing, and harrowed it; another in June; and a third in July, when it was sown with turnips. This crop proved remarkably fine, and was transplanted for seed, in rows at thirty distance; and the produce was seventeen bushels of fine seed, per acre.

He then subjoins another instance, where a method, as nearly similar as circumstances would admit, was applied to wheat, and the crop was astonishingly luxuriant and abundant. As soon as the

wheat was cut and removed, the stubble was burnt, and the ground ploughed and harrowed as a preparation for turnips, but as the weather was very dry, (1802) the seed did not grow. In the following March (when it was intended to plough the ground for a spring crop) there appeared to be a very regular crop of wheat, risen from the seed which had been shed the preceding harvest: he therefore sowed it with clover and ray-grass, and harrowed and rolled it. The produce of this second crop of wheat, was seven coombs (28 bushels) per acre, and the grasses were very abundant, and afforded an excellent crop of hay the following summer. This piece was kept fed close, to thrash and set hemp upon, which, however, was not quite sufficient in quantity to cover the whole field. Mr. Herod had always found a difficulty in making clover flourish the second year, though he had repeatedly attempted it; in this instance, however, he got a better crop the second year, than the first, except on the small part which was not covered with the hemp; there the clover withered away, and only the ray-grass came to the scythe, though all the piece was manured alike. The writer communicated this circumstance, though not immediately connected with the subject of the paper, because he thought it worthy of remark, and deserving the attention of other agriculturists, being occasioned by some peculiar quality in the hemp, which is at present unknown.

Observations.—The reasoning, and the experiments of this intelligent farmer in favour of *long fresh dung*, as preferable to rotten, are too well founded, to be easily set aside. The very general custom of suffering dung to rot before it is applied as a manure, has established a general prejudice in favour of the practice; but if one of the chief benefits arising from the application of dung, be the fermentation thereby produced in the soil, (and this is a fact generally admitted) that benefit must be in proportion to the degree of fermentation, and this must necessarily be greater from fresh dung, than after much of the fermentative power has been exhausted in a dunghill. Though many attempts to apply long dung as a manure, have not been attended with the expected success, and particularly on light and sandy soils, this circumstance ought not to operate to the complete exploding of the system; for a good plan is often badly executed, and then condemned. The want of success in the use of long dung, is frequently to be attributed to the improper manner in which it is applied. Farmers too often, from inattention, lay it on the land at the same time as they lay on rotten dung, whereas it ought to be applied much earlier, for it requires a much longer time to ferment and incorporate itself with the soil, than if it had remained in a dunghill, till nearly pulverized. The manuring with rotten dung, upon wet and heavy lands, is allowed to be contrary to reason and experience, and the same beneficial results might be confidently expected from the application of

long dung to lighter soils, as is found to arise from it, on wet soils, if a longer interval was allowed before the crop was put in. No agriculturist can ever see without regret, very large heaps of dung carried into the open fields, by which practice its essence is exhaled in the air, and lost for ever to the owner, instead of being buried in the ground.

With respect to the very luxuriant produce of the clover in the second year, in consequence of being covered by the hemp, it may be attributed to another cause, than any peculiar quality residing in the hemp itself. It may have been caused from the circumstance of the clover being long covered and sheltered from the intense heat of the sun at the period of the year when hemp is spread on the ground, and from the supply of moisture derived from the hemp, after its removal from the retting-pool. Clover is a repent plant, and the root partakes of the nature of the leaf, and spreads itself laterally so near the surface of the ground, as often to be partially above the soil; for which reason it suffers much from the rays of the sun, and never grows so well when sown alone, as when sown with a crop of corn, which may shelter it in its infant state. The laying the hemp on the clover crop afforded similar shelter the second year, and not only screened the roots from the sun's heat, but afforded a regular supply of moisture at the same time. As this cause is fully sufficient to produce the effect recorded, we see no reason to resort to any other, or to suppose with Mr. Herod, that it originated in any peculiar quality of the hemp.

On the Norfolk Plough. By Mr. Thomas Balls, *of Saxlingham Hall, Norfolk.—Annals of Agriculture,* No. 263.

This gentleman has applied much study to the improvement of agricultural implements, and directed his attention more particularly to the improvement of ploughs, from some correspondence with Mr. Young on the subject. He had long considered the Norfolk plough to be defective in its parts, and capable of being much improved, especially in the line of draught, however high it had stood in the opinion of many agriculturists. The improvement, which he describes in this paper, consists in a *concave* beam, in lieu of the old form (convex) with beam chains, leading from the heel to the *loads*, forming a straight line of draught to the horses' shoulder. The old plough, drawing above the coulter-hole, with an obtuse angle and bent line of draught, evidently occasioned much friction on the ground irons and wheels; and in very hard work, the beam itself was liable to break in the coulter-hole; for every hole it is let down to plough deeper, the beam becomes weaker, and the angle of draught more obtuse; and

consequently the friction is increased, and the plough more liable to be pulled to pieces. Mr. Balls observes that the very reverse happens with his improved plough; for, drawing below the coulter-hole, every time it is let down, the angle of draught becomes more acute, till you draw immediately from the heel of the plough, which forms the most acute angle possible, in the line of draught to the horses' shoulder. This plough, he adds, may be set to such an angle, as to find its own equilibrium between the resistance of the furrow-slice, and the power of the draught applied to overcome it, acting upon the principle of the lever, so that it requires but little more weight or power of draught, to overcome the resistance of a six-inch depth of furrow, than a four-inch one; whereas in the common plough the resistance is increased nearly one hundred weight every inch it is let down. He recommends that no plough be set to carry a furrow more than eleven inches, though it need not be less than eight; remarking, that no person will hardly credit the difference which an inch on the breadth will add to the power of the horses' draught, unless they obtain conviction, from calculation. He instances, that, with a plough, from the heel to the point of the share, two feet six inches long, eleven inches broad, and depth of furrow, six inches, there must be a power applied equal to overcome a resistance of 1980 cubic inches of earth, in being moved the length of two feet six inches; while his plough of the same length, from the heel to the share, and eight inches broad, offers a resistance of only 1248 cubic inches for a furrow of the same depth; and there is proportionally less friction with the latter, than with the former. He asserts his conviction, *from experience*, that a plough for properly pulverizing the earth, ought never to be set to carry a furrow of more than nine inches, that is, four to a yard. A pair of horses will then plough an acre in five hours, walking exactly eleven miles in performing the task.

Observations.—Without an opportunity of seeing a plough work, with such a beam as Mr. Balls recommends, it is impossible to say that it embraces all the advantages which he attributes to it. The theory, however, is accurately coincident with the philosophy of mechanics, and the only doubts, which present themselves, are with respect to the quantity of friction being diminished, for it is not very easy to conceive how, if an equal quantity of surface comes into contact with the earth to be removed, in each case, there can be any other difference of friction, than the difference of weight and cohesive power of the earth, which certainly is not equal to the difference of power required, but in most cases, much less. If, however this doubt should be borne out by experiment, it diminishes the merit of the improvement in but a very small degree. Both reason, and the principles of mechanism require that the line of draught should be varied with the depth of furrow, and yet in most ploughs this is impossible. Mr. Balls' plough-beam will be imitated very

generally by those who understand the impor;ance of the line of draught; and the breadth of furrow he recommends is certainly very proper for Suffolk and Norfolk, and similar light soils; but a narrower furrow is to be preferred, where the land is wet and heavy.

Experiments made with the Fen-paring Plough, on a wet loamy Soil. By Mr. YOUNG.—*Annals of Agriculture,* No. 263.

THE editor of the Annals of Agriculture in breaking up a chicory lay in 1801, for dibbling for oats, ordered an acre to be left for trial with this plough. He employed a skilful workman to pare it one inch deep, though much of it was nearly two inches. Though the land was not free from stones, yet this plough performed the work better than any other would have done, with which he was acquainted. The turf was burnt in heaps; and the season not being favourable, the expense was about 45s. an acre. The ashes were spread and ploughed in shallow, and the oats harrowed in. The burnt part of the field produced nearly double the crop of the other part, and the same superiority was found in the following years.

Observations.—It is difficult to conceive what argument in favour of the *Fen-paring plough* can be drawn from this account; the same result would have been the consequence of paring and burning in the common way. If Mr. Young meant to assert (as we suppose he did) that the fen-paring plough would produce every effect of breast-plowing, at a much less expense, and supersede the use of the breast-plough entirely, by becoming a substitute for it, he certainly has not conveyed that idea with sufficient plainness and precision.

On Ear-Cockle in Wheat. By Mr. JOHN BANISTER, *of Horton Kirby, Kent.—Annals of Agriculture,* No. 263.

EAR-COCKLE being supposed to prevail most in those grounds where the crops had been raised from seed purchased of the farmers at Cobham, this writer endeavoured to ascertain the fact by putting enquiries to the farmers there. They acknowledged the justice of the observation, but are wholly ignorant of the cause; he received the same answer from agriculturists in the neighbourhood of Sittingbourne; and a friend, who resides near Henley-in-Arden, informed him that the disease was wholly unknown in that part of Warwickshire. Having been unsuccessful in his enquiries, he ventures to communicate his own conjectures on the

subject and supposes that some of the farina fœcundans of the common cockle, growing adjacent to the wheat ear, may have formed a lodgement on the male blossom, and by the filaments insinuate itself to the female blossom within the chest of the ear; wherefore, if this hypothesis be well founded, it is easily to be conceived that such a junction may produce ear-cockle; or, as the Essex farmers term it, the purples. He is strengthened in his conjecture by the well known circumstance that cabbage stalks, which are preserved for seed within the contact of savoys, brocoli, &c. blossoming at the same time with the cabbage stalks, will occasion a spurious kind of cabbage seed not to be depended upon. It was agreed on by every farmer whom he consulted on the subject, that the wheat sown from fields where the ear-cockle prevails, will certainly produce ear-cockle at the next harvest. The cause here assigned is the only one, which on a careful investigation of the subject he is enabled to offer.

Observations.—The ear-cockle is a disease which prevails only in particular districts, and in them it is extremely common. This circumstance affords reason for believing that it is propagated with the seed, and the ears of wheat which produce it are evidently a spurious production. The cockle is frequently in flower at the same time with wheat, and the transmission of the farina from the one plant to the other is an occurrence which often takes place in the vegetable kingdom. The fact might be ascertained by experiment, and the opinion suggested by this writer disproved or confirmed

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On Buck Wheat, as a Preservative of Turnips against the Fly.—*Annals of Agriculture,* No. 263.

This communication is a letter from Mr. Barrow, the secretary of the Newark Agricultural Society, stating, that numerous trials of buck-wheat, as a preservative of turnips from the fly, had been made by members of that society, and that it appeared from the results communicated at a meeting that *buck-wheat* is NOT a preservative of turnips from the fly.

Observations.—The most effectual method of preserving turnips from the fly is contained in a letter from Sir John Jervis of Ireland to the editor of the Annals of Agriculture, noticed in the 7th number of this publication.

Description of the Rev. Mr. PRIEST'S *Wheat-dropping Barrow.*—*Agricultural Magazine,* Second Series, No. 10.

THE frame is made in the shape of a common wheelbarrow, with a wheel of 22 inches diameter, but instead of the containing part two hoppers are placed in the frame, one on each side the wheel. At the bottom of each hopper, is placed a cylinder, with excavations to contain the seed, and a brush is placed within the hopper to prevent any more seed passing out than what is contained in the cavity. The field is previously rolled, and then the crop deposited by a man driving the barrow from one end of the lands to the other at equal distances, and covered by harrowing or a second rolling.

Observations.—This barrow is precisely the same as Mr. Plucknett's patent hand-dibbling machine, an account of which will be found in the 2d volume of the Retrospect, page 526, to which the reader is referred.

The Mode of managing, and the Produce per Acre of a Crop of Flax, in Norfolk. By JUVENIS.—*Agr. Mag.* 2d Series, No. 10.

IN the Marsh-lands in the county of Norfolk, flax seed is stated to be in general sown broad cast, about eight pecks to the acre; and the same quantity is sometimes drilled at nine inch intervals, and harrowed with a light harrow. It is sown at the end of March, or beginning of April. The weeding is done by women crawling over it on their knees, which is no ways injurious to it. When flax is pulled before it is ripe, it is termed white flax; when the seed is allowed to ripen, seed flax. When white flax is pulled, it is tied up in small sheaves about as thick as a man can hold in both his hands, and laid upon the ground for a day to dry, after which it is carried to be retted or steeped in stagnant water, in which it is laid with the tops uppermost, and covered sufficiently thick with sods, as to be kept under water. When it is sufficiently wetted the hop will come off, and the flax easily parts from the boon. It is then taken out of the water, and spread upon a meadow, and as soon as rain has sufficiently washed the soil from the top-side, it is turned over, which is repeated as often as is necessary till it is completely blistered in the boon; it is then gathered up perfectly dry, and deposited in the stack or barn. It is dressed by hand at an expense of 2s. per stone. Seed flax is pulled in smaller

sheaves than white flax, and may either be whipped out in the field, or stacked up till the Spring, as the seed is equally good in either case.

				£.	s.	d.
The produce per acre of a middling crop will be 40 stone of 14lb. at 10s per stone,				20	0	0
Expence.—Rent	£4	0	0			
Seed, 8 pecks at 3s	1	4	0			
Plowing and harrowing	0	12	0			
Pulling and retting	1	5	0			
Weeding twice	0	6	0			
Spreading and gathering	0	4	0			
Dressing, at 2s per stone	1	0	0			
				11	10	0
Profit per acre				8	10	0

Observations.—The method of cultivating flax which is here described, is so similar to that practised in Argyleshire, and other districts where this plant is sown, as not to afford much information to the growers. It is however sufficiently explicit to enable any one to commence the cultivation of flax, and exhibits a plain outline of the process to the inhabitants of those districts, where flax is at present unknown, which are by far the greatest part of Great Britain.

On the most proper Season for laying on Dung in the Northern Districts. By S. S.—*Agricultural Magazine*, 2d Series, No. 10.

The circumstances of applying manure with the greatest advantage is represented to be of very material importance to the farmer. To accomplish this, the writer thinks the proper season for laying dung on meadow or ley grounds to be immediately after they are mowed or pastured, and on arable lands that are to be ploughed before winter, as soon as possible after the crop is removed, in order to rot the stubble and weeds while the sap is in them, which will be a considerable addition to the dung: the sooner it is then ploughed, the better, as it would suffer from being exposed to frosts and rains: if however the arable land cannot be ploughed before spring, he thinks it best not to lay the dung on till that time. In this case the dung may be put into an oblong heap, compactly made, and allowed to lie till the warmth of spring shall make it ferment; immediately after which it should be minutely spread, and ploughed down as soon as possible, and before its heart and juices can have had time to evaporate; for dung, if kept long after its fermentation is over, will lose much of its virtues.

Observations.—The remarks contained in this paper, contain no new information; they are however sensible and just, and the conduct recommended has been long adopted by most judicious Agriculturists.

Cursory Hints on the most proper Breeds, and the Working of Oxen. By X. Y.—*Agr. Mag.* 2d Series, No. 11.

In this paper the *Devonshire* breed, and its different varieties, are said to be unquestionably the most adapted to farm labour, both from their quick step and capability of standing work well, either on hilly or vale lands. The *Carmarthen* breed is mentioned as a kind of cattle that comes in the next place as team oxen, being also very quick on their legs, and excellent beasts for grazing or filling themselves after they have left their work. The *Herefordshire* breed is admitted to possess much beauty, as well as strength and size, especially when full grown, and to be capable of doing work well; the only objection to them being, that of their requiring better keep than either of the above breeds, which are, in the opinion of this writer, very far before them, for the purposes of field labour. Besides these three breeds, the long-horned, or *Lancashire* improved oxen, are thought often to answer as well as team oxen, being constantly made use of in the northern districts of the kingdom.

When these animals are used, it is recommended that care should be constantly taken to keep them in a full manner, and not to overwork them; and where four are driven in a team, to keep six, that two may be changed every day, and in like manner that three or four should be kept where two only are used; for this method will give them rest as well as improve the beasts.

Observations.—The remarks on the comparative merit of the different breeds of working oxen, are in unison with the opinions of the most experienced farmers who use them, but circumstances and situation frequently render it adviseable to work Herefordshire oxen in preference to the Devonshire or Carmarthen breeds. In the north of England these could not be obtained, but at a much greater expense than the Lancashire. The advantages of permitting the labouring ox to rest every third day, is too plain to admit of an argument, but few farmers will be prevailed upon to keep more oxen than they want at an additional expense of capital and food, which after all the advantages of rest to the animals, may not remunerate the increased expense.

Account of several Papers on Spring Wheat. By Sir Joseph Banks, *Bart. by Mr.* Peter Sers, *by* John Coggan, *Esq. by Mr.* Calthorp, *by* Nath. Wedd. *Esq and by Mr.* Wm. Speechly, *Com. to the Board of Agriculture, Vol. V.*

No. I. *By the Right Hon. Sir* Joseph Banks, *Bart K. B.*

The intelligent Baronet describes spring wheat (the triticum cestivum of Linnæus) as a grain too tender to bear the frosts of the winter, but as quick in progress from its first shoots to ripeness as any other spring corn. It is well known on all parts of the continent, and is called by the several nations of the south of Europe by a name indicative of its peculiar seed time, and which distinctly marks the difference between this and winter corn. He has not discovered from the older books on husbandry that it was very early cultivated in England, and thinks that when early writers mention spring wheat, they speak of a kind of winter wheat, which will ripen when sown after turnips in February. The real spring wheat is stated to have been longest known in Lincolnshire, in the lower parts of which it is now cultivated to a great extent. The premium offered by the Board of Agriculture for the greatest quantity sown in 1805, was claimed by Mr. Sers, of Gedney, near Spalding, who sowed in his regular course of cropping 241 acres. Sir Joseph remarks that this gentleman, who has raised himself to opulence chiefly by the culture of this grain for the last thirty years, sows spring wheat from the 25th March to the first week in May; for a full crop he sows 14 pecks on an acre, and expects to reap four quarters; if he sows nine pecks, he expects to reap three quarters; he finds it thrive nearly as well on stiff as on light land, and has found it by experience to be exempt from the mildew or blight, and from all damage of the grub or wire-worm. The farmers of South Holland, (in which division of the county of Lincoln Spalding is situate,) uniformly admit that they have been compelled to abandon the cultivation of winter wheat, from the frequent attacks of the mildew, and have substituted spring wheat in its stead, and never find the latter affected by that disease. The land, in the neighbourhood of Horncastle, is either light or sandy, or chiefly composed of white clay, and though tolerably productive in barley and seeds, is not to be compared with the rich and fertile districts of South Holland, and yet the culture of spring wheat has increased, and is still increasing in that neighbourhood. Sir Joseph Banks remarks, that the grain of this kind of wheat is much smaller than that of winter wheat, and so nearly resembles red Lammas wheat in colour, that it may be mixed with that grain without any injury to either the seller or the buyer, for it weighs very heavy, and yields better at the mill than might be expected from its appearance; seldom weigh-

ing less than 60lb. to the bushel. In the countries best acquainted with its culture, he says it is preferred to all other corn for raising a crop of seeds, which is owing to the small quantity and the short duration of the leaf, which has no sooner attained its full growth than it fades and falls. He recommends it as a simple and easy remedy in cases where red wheat has been damaged by the wire-worm; for if the seed of spring wheat be either dibbled, or only raked with a garden rake in the first week in May into the naked spots left by the worm, though it will not attain the growth at which the worm begins to prey upon it till he has changed his state for that of a winged beetle, will yet certainly be ripe as soon as the winter wheat, and may be threshed out and sold with it.

In years of scarcity, he observes, this wheat offers a resource which may occasionally be of the utmost importance to the community; for the price of wheat seldom advances much till a considerable portion of the crop has been threshed out, and the produce of it by this means ascertained; and though this does not take place till after it is too late to increase the crops of winter wheat, yet it generally takes place before the end of April, while spring wheat may yet be sown in aid of the succeeding crop. He laments that the progress of agricultural improvement has in some instances advanced in the inverse ratio of the utility of the novelty recommended to the public, and fears lest the general culture of spring wheat, even under the liberal protection it has received from the Board, should be retarded by this principle; he thinks it therefore advisable to state that the cultivation of it is now fully established in the neighbourhood of Boston and Spalding, in Lincolnshire, and that the seed may be obtained without difficulty from either of these places. An experiment is added, to shew that spring wheat will succeed as well by dibbling as by broad-cast. In 1804, Mr. William Showler, of Revesby, in Lincolnshire, dibbled four pecks and a half on an acre and two roods of middling ground, which had borne turnips the winter before, and had received no extraordinary preparation, and the produce was seven quarters.

An analysis in the wet way is subjoined, which was conducted by Mr. Davy, of the Royal Institution, from which the following results were obtained from different kinds of wheat:

	Gluten.	Starch.	Insoluble Prts.
From 100 parts of best Sicilian wheat,	21	75	5
of spring wheat of 1804,	24	70	6
of good English do. of 1803,	19	77	4
of blighted do. of 1804,	13	52	44

It is declared to be a fair deduction from this analysis, that bread made of the flour of spring wheat is more nutritious than that made of winter wheat, for the former contains a greater proportion of gluten than the latter. Bread made of spring wheat is however represented to be rather less white than that made from

the better sorts of winter wheat, but at the same time is allowed to be more palatable, both which qualities are attributed to the gluten contained in it.

No. II. *By. Mr.* Peter Sers.

This communication is from the Lincolnshire agriculturist mentioned by Sir Joseph Banks. He merely states, that he has sown the quantity mentioned in the letter of the Right Hon. Baronet, and expects a crop of four quarters per acre, and that his time of sowing is from the 25th of March to the 4th of May. He relates that the wire-worm had never hurt the spring wheat, though it had materially damaged the winter wheat; and that though the mildew had often proved fatal to the latter, it had never been found upon the former. The certificate required for the premium, and a note to Sir Joseph Bank, which inclosed a specimen of his crop, for the inspection of the Board, are subjoined to the communication.

No. III. *By* John Coggan, *Esq.*

This gentleman admits that he was induced to sow spring wheat solely by the advertisement from the Board. He sowed twenty-two acres and an half of land, seventeen and an half of which was little better than a common. The quantity sown was three bushels to the acre, and the produce above sixty quarters of marketable wheat. Of the land thus sown, five acres were part of a common which had been inclosed in 1803, and the furze grubbed up in September that year, and had been ploughed very deep in the spring of 1804, and planted with potatoes, which produced above 400 bushels per acre; this was sown with spring wheat on the 11th April. Three acres more of the same common, which had been sown with and produced an excellent crop of hog-peas, were ploughed in February 1805, and sown also on the 11th April. Eight acres more of this land, which had been broken up in January 1804, and sown with turnips in June, which were early fed off, were sown the same day. An acre and a half of the common, not yet cultivated, was, for the sake of the experiment, unturfed, and sown with spring wheat upon one ploughing: the seed came up well, but went off fast in about a month after, and was a very light crop at harvest. The other five acres had been in cultivation many years, but had been much neglected previous to the inclosure: but it was summer-fallowed in 1804, and sown with turnips in August, which were fed off with sheep in the spring of 1805; it was ploughed early in April, and sown with spring wheat the 19th of that month. The wheat which was grown upon the common was all of a dark colour and very cold, and weighed 56½lbs per bushel; there was no appearance of blight during the time of its growing, but a violent storm in July beat it down flat, from which circumstance it suffered much. The wheat grown in the arable land was of a fine colour

and excellent quality, but partook somewhat of smut; it weighed 59½lbs per bushel. The seed was procured from Rye, in Sussex; it was a bearded wheat. All the corn came up in a few days after it was sown, was regular, and wonderfully quick growing; and though the red gum attacked the autumn wheat in the next field, which was separated only by a ditch and hedge ten inches, yet it did not attack the spring wheat.—Mr. Coggan considers his experiments to have been made under great disadvantage, only five acres of his land being properly arable, and that in an exhausted state, and the remainder a furze common without manure, and which had not been in tillage beyond the memory of man.

No. IV. *By Mr.* CALTHORP.

Mr. Calthorp's farm is situate in Gosberton fen, in Lincolnshire, which had been inclosed about six years. The land sown was 42 acres of moor-land upon a substratum of clay, and 40 acres of the same moor-land upon sand. He sowed 20 quarters of the horned, or rough-eared spring wheat, which is eight pecks to the acre, and the produce was 413½ quarters of good wheat, and 26½ quarters of refuse corn: the value of the former was 50s. per quarter, and of the latter 25s. the crop suffered in some degree from the smut. He states himself to have been in the habit of growing spring wheat for 25 years, and never knew it suffer from the mildew, as winter wheat frequently does.

No. V. *By* NATHANIEL WEDD, *Esq.*

This gentleman, in 1805, sowed 82 acres, 2 roods, 7 perches of spring wheat at Soham, in Cambridgeshire: half of the quantity was estimated to produce four quarters per acre, and half 3½ quarters per acre. This was nearly all grown upon fen land, with turf earth underneath, which he considers best adapted to the growing of spring wheat, because fen land will grow more rapidly in the spring than any other. The previous cultivation was ploughing, then burning, and sowing with cole-seed, which was fed off by sheep, after which the spring wheat. The sowing commenced the beginning of March, and ended the last day of April; the earliest sown was the best quality, and yielded the greatest produce. Mr. Wedd has found spring wheat to be always free from mildew at the times when both red and white wheats were much affected by it.

No. VI. *By Mr.* WILLIAM SPEECHLEY.

The experiments with spring wheat made by Mr. Speechley were, 1. With a view to ascertain the comparative difference in point of *quantity* between autumnal-sown Lammas wheat and spring wheat, on clover lay. 2. The effect of top-dressings on spring wheat on clover lay. 3. Whether spring wheat sown on clover lay, or upon turnip fallow, will prove the more successful.

In October 1804, he sowed one half a close, containing eight acres, with Lammas wheat, on clover lay; the soil a crumbling

loam, but thin, by laying near a scaly rock bottom. In April, the remaining half was sown with spring wheat, in a small portion of which the following top-dressings were applied, viz. dove-manure, soot, a compost of sheep's dung, leaves of trees, &c. and very rotten stable-yard manure. The crop throughout was thin, both of the autumnal and spring-sown wheat. When threshed, the Lammas wheat yielded not more than 21 bushels per acre; and the spring wheat, where no top-dressings were applied only $17\frac{1}{2}$ bushels per acre: that part manured with dove-manure was best, that with soot very little inferior; the effects of the compost of sheep's dung, &c. and of rotten stable manure, were nearly equal: the two former top-dressings produced an increase of six bushels per acre, and the two latter an increase of three bushels per acre to the produce of that part which was not top-dressed. In the same month, and also about the middle of it, he sowed four acres of spring wheat on turnip fallow, the soil of which was a deep loam, and in a high state of cultivation: the turnips were very free from weeds, and had been eaten off by sheep. The wheat crop from the beginning shewed the highest marks of vigour, and was no where laid. The produce was estimated at four quarters on an acre. Though the produce here was so much greater than on the clover lay, he does not think the difference in point of *quantity*, between that sown on clover lay, and that sown on turnip fallow, ought to be considered as any data to go upon in future experiments, because of the superior quality of the soil in the latter case. The advantage of top-dressings was sufficiently apparent, and he conceives the most eligible way of applying them is at the time when the wheat is sown.

Observations.—The great importance of every means which tend to obviate the deficiency of the wheat crop, will prove a sufficient apology for the length to which this article is extended. Whenever there is a general appearance of defect or deficiency in the autumnal-sown crop in the early spring months, whether from the preceding seed time having been unfavourable from the severity of the weather, or from long continued rains, spring wheat may be sown in such a proportion as may suffice for yielding a produce equivalent to the expected deficiency. And whenever wheat may bear a high price in the spring, nothing will so effectually keep it at its proper level as the certain prospective of a productive harvest, which may always be brought about by sowing a larger quantity of spring wheat. Besides, this kind of wheat is less liable to accidents than that which is usually cultivated; no instance has been known of its being attacked either by the wire-worm or the mildew, both of which are frequently very destructive to the crops which are sown in autumn. It also affords the husbandman an opportunity of previously obtaining a crop of turnips after his fallow, and thereby enables him to augment the number of his live stock, and consequently to obtain a great quantity of dispose-

able manure. The analyis of Professor Davy has ascertained its value for making bread, for it has been shewn to contain a greater proportion of gluten than winter wheat, and gluten is the nutrition which bread affords. Its value and importance then being admitted, the cultivation of it demands general attention; and these communications to the Board of Agriculture demonstrate that the cultivation is easy and profitable in all soils, and impracticable on none. Fen land, however, is more peculiarly suited for the purpose, on account of the very rapid progress of vegetation in the spring on such land. The cultivation of it in Lincolnshire is gaining ground every year, and the sowing of winter wheat is nearly discontinued in the fen and marshy districts. The premium offered for its growth by the Board of Agriculture has been productive of much benefit to the country, inasmuch as it has caused the virtues of a grain, which was only partially cultivated before, to be generally known. It is no small advantage that a failing crop of winter wheat may be raised to its expected produce, by raking spring wheat into the vacant places in the beginning of April, and till May; and though the sample may not be quite so uniform, yet a small deficiency in price will be more than recompensed by a greatly increased produce of quantity.

An Essay on the Cultivation of Potatoes. By the Rev Edm. Cartwright.—*Com. to the Board of Agriculture.* Vol. v.

Mr. Cartwright observes, that though potatoes have been naturalized to this climate for nearly two hundred years, yet they have not been considered as objects of field culture more than fifty, nor have been introduced into gardens above twice that period. The original country of the potatoe, is stated to be Brazil; and yet being a native of the mountains at such an altitude, above the general surface of the country, as not to suffer by too hot or too cold an exposure, it is the production of a temperate climate, though its native country is situated between the tropics; for this reason it accommodates itself to the vicissitudes of an English atmosphere, with nearly the facility of an indigenous plant.

The method of raising potatoes from seed is first treated of, and it is observed, that the apple of the potatoe, which contains the seed, rarely finds sufficient heat in this country to ripen. The apples, however, may be gathered with the stalks, and hung up in some warm place, where there is a constant fire; in the course of the winter, the apples will become pulpy, which is an indication that the seeds are ripe, and they may then be separated from the pulpy part either by washing or otherwise. After the seeds are separated and rubbed dry, they are fit for sowing in the succeeding spring, when they may be sown on a warm border,

but as the plants will not make their appearance for several weeks, it is better to sow the seed in pots or boxes, which may be brought under cover in bad weather, for when the seed is sown in hot beds, the plants are almost always sick and weakly, though they arrive sooner at maturity. In May or June, the plants may be transplanted where they are to remain, and in doing this care should be taken to select a warm situation, and they should be put in at such distances from each other, as that their roots may not interfere; and on the first appearance of frost, they should be taken up out of the ground: a single potatoe will be sufficient to reserve from each root the first year, for as this vegetable does not assume its permanent character at one year from the seed, no judgment can be formed of its future qualities at that stage. When the reserved potatoes are planted the next year, great attention should be paid to their time of ripening, which may be known by the deadness of the haulm, as the value of a potatoe is greatly enhanced by its coming soon to maturity. Though no varieties were to be obtained by raising potatoes from seed, yet there will be found a great advantage in the practise from the new kinds being more prolific, than those which have been raised repeatedly from sets through a long course of years.

CHOICE OF SORTS is also recommended: those who intend raising potatoes for the purpose of feeding animals, have been advised to cultivate those which are most prolific without regard to the quality; but this writer thinks, the practise cannot be too severely reprobated, both as injurious to the community, and as not the most beneficial to the growers themselves; for so long as there is a market for potatoes, as an article of human food, they will always bear a better price than the grower can make of them by giving them to animals and even for this purpose the best sorts will be found the most profitable; for the most nutritious part of this excellent vegetable is the farinaceous, or mealy part, and the least nutritive, or rather the deleterious part, is the aqueous, and a dry mealy potatoe yields more farina by one part in four than a waxy one.

THE SOIL PROPER FOR POTATOES, AND ITS PREPARATION ought also to be considered, for though potatoes will grow on any soil, yet they ought not to be cultivated on that which is cold, stiff, or wet. The best soil is a rich sand or a light loam, though any which are dry and warm, if well manured and kept free from weeds, will make ample returns of crop, if cultivated with potatoes. It is recommended to give land intended for potatoes a ridge ploughing before winter, provided it be not a light sand: in the month of February it should be again ploughed and harrowed down, and in that state should remain till the seed weeds begin to vegetate, which may be then more easily destroyed; after which a slight sprinkling of well-digested dung should be equally spread over the field and ploughed in. But, perhaps, the best prepara-

tion for potatoes is a crop of turnips consumed on the ground; in that case nothing more is required than to give a single ploughing followed by a liberal use of the harrows.

In MANURING for potatoes, it is a prevailing custom to use long litter, old thatch, and even stubble, heath, or any other substance, which will keep the ground hollow, under the idea that the young tubers of the potatoes have by such means more room to spread and expand themselves: and where the soil is a stiff clay, it must be confessed to be highly expedient, but the manures most proper for potatoes, when cultivated in land which suits them, are those which mix and unite freely with the soil. The most advantageous way of applying manure for this crop is, perhaps, to give part at the time of planting, and the remainder as a top-dressing immediately before earthing up: top-dressing is applied with peculiar advantage to a potatoe crop, as it can be given at the precise period of time when it is most wanted, and immediately ploughed in, by which means it loses not a particle of its fertilizing quality by exposure to the exhaling influence of the atmosphere.

A very common METHOD OF PLANTING potatoes, is to form the land into ridges from two to three feet wide, which are filled with manure, on which the sets are deposited, and then covered by a double mild board plough: others plant them on a level after second or third turn of the plough; but both these methods are irregular. The mode recommended and practised by Mr. Cartwright is this: the land being previously made fine by the plough and the harrow, is marked out into drills nine inches asunder; the implement he makes use of for this purpose, is what is called Ducket's drill-maker with five shares; the drills being formed, an implement consisting of a pair of wheels not quite twelve inches in diameter fixed upon an axis at nine inches apart, and having on their circumference a tooth or projection at every nine inches, and so placed as that the wheels shall mark alternately as drawn along two of the drills, and make an indenture in each drill at every nine inches; it then misses one drill and returns: the indentures being made, the planter then follows and drops in the sets, planting both drills as he goes: when the planting is finished, the field is run over with a bush or other light harrow, and then rolled. When the plants are three or four inches high, the ground is flat hoed, and after they are advanced as high again a top-dressing of any suitable manure is applied. By planting the sets uniformly the greatest possible number of plants are set in a given space without loss of ground, and at the same time without being crowded.

THE ADVANTAGE OF TRANSPLANTING POTATOES also gives this crop a superiority over most others; for they may not only be put imto the ground from the middle of February to the be-

ginning of June, but they may be transplanted during the whole of that period with the greatest success. The writer enumerates many experiments of transplanting which succeeded to his utmost wishes, and produced equal to those which had not been removed. This practice, he observes, besides suggesting hints to the farmer, may furnish valuable information to the small cottager; it will teach him that after his little garden has produced him a crop of early spring and summer vegetables, he may obtain from it, by being provided with a nursery bed of potatoe plants, a valuable stock of food for his winter consumption.

In TAKING UP AND STORING potatoes the first thing to be attended to is to clear the ground of haulm, and then to gather such potatoes as appear on the surface, which answer for sets as well as any other, though they are inferior for culinary purposes. Whether taken up with the fork, the spade, or the plough, the persons employed to gather the crop, should be supplied with two if not three baskets, for the purpose of separating those of prime and middling quality from the refuse; and they should be spread abroad for two or three days, that they may be perfectly dry previous to there being stored, lest when they are laid by they should ferment and be spoiled; for in storing potatoes it is necessary to take care they be kept dry and out of the reach of frost.

ON THE APPLICATION OF POTATOES AS FOOD FOR ANIMALS, much has been said and written, and though Mr. Cartwright differs from most writers, in supposing that simple boiling is as cheap a way as any by which they can undergo a culinary process, yet he prefers either steaming, roasting upon kilns, or baking; for by any of these processes the watry particles are dissipated without the chance or possibility of being reabsorbed, as will inevitably be the case in boiling, unless they are taken out of the water before the ebulition subsides. The most valuable purpose to which a farmer can apply his potatoes, when he can no longer find a market for them, is, in the opinion of this writer, to give them to his sheep at such times as they are prevented by frost and snow from getting at the turnips, in which way they may be applied to great advantage.

The only DISEASE to which potatoe plants are liable is the curl; the appearance and effects of which are universally known. About twenty-five years ago, this disease was alarmingly extensive, but has gradually abated without the cause being certainly discovered. It is remarked that the sets producing curled plants seldom dissolve, coming up in autumn to all appearance in as perfect a state as when first deposited in the ground; and it is said to have been proved by experiment that a potatoe which cuts hard or woody, will infallibly produce curled plants, and such as yield freely to the knife may be expected to produce healthy ones.

The Essay concludes with some GENERAL OBSERVATIONS which are not confined to the cultivation of the potatoe only. The

writer states it to be a received maxim, that the same crop ought not to be grown on the same land for a succession of years, under the idea that to bring any particular vegetable to maturity requires a specific kind of nutriment of which the soil would be exhausted in a short time, were it to produce the same species of plant every year, but he holds this idea to be erroneous, though he thinks a rotation of crops very beneficial, for this rotation enables the farmer to repair the exhaustion of one crop, which is reaped and carried off the ground, by the interposition of another which is manured for and consumed upon the land: and he is of opinion, that were it practicable to cultivate wheat so as that the crop could be produced every year perfectly free from weeds, even that grain might be continually repeated by the assistance of sufficient manure to repair the annual exhaustion of the soil. This reasoning is confirmed by the practise of the potatoe-farmers in Yorkshire, who regularly repeat the crop on the same ground for the supply of the London markets: it is probable, however, that every plant would not admit of being cultivated every year in the same field on account of the multiplication of particular insects, it being reasonable to conclude that insects will multiply in a soil which supplies them with food; for nature has ordained that where the insect finds its food, there it should deposit its eggs, or remain buried in the ground till the returning season: upon this principle it is suggested that the failure of red clover may be accounted for, if repeated on the same ground at a less interval than four years. The supposition that the colour of the potatoe blossom depends on the colour of the potatoe itself, is stated to be a mistake, for the kidney potatoe only produces a white blossom. The potatoe is so tenacious of life, that if it be pared and cut into cubes of about an inch square, and these cubes kept in a dry place for a day or two that they may heal over, each of them when planted will vegetate, and produce healthy vigorous plants and come to maturity. Potatoes are reckoned best for domestic purposes, when taken fresh out of the ground; and if designed for the table, are much improved by being boiled in milk, because the milk requiring a greater degree of heat to bring it to the boiling point than the watery part of the potatoe, the watery part of the potatoe is exhaled into vapour and expelled before the milk boils; and even should the potatoe remain in the vessel, which it ought not to do, after the ebullition ceased, it would absorb and be saturated with the milk only instead of receiving back its own juices.

Observations.—Though this essay does not contain much new information respecting the potatoe, it may yet be considered a valuable history of that useful plant; many of the observations tend to elucidate appearances, which have not been before suffi-

ciently accounted for; particularly the cause why potatoes become less productive after having been planted for a series of years, which may be safely assigned to the cause of age in sets, which can only be referred to the time of their being raised from seed, as the period of their original existence; and this idea is perfectly analogous to the known laws of nature in the animal creation, who certainly propagate their species less perfectly in age than in early life. We believe this principle was first discovered to exist in vegetables by Mr. Knight, of Herefordshire, and explained in his ingenious Treatise on the Culture of the Apple and Pear; and we can see no reason why the same analogy should not obtain in all species of the vegetable creation, which are not raised from seed; for all of these produce seed in maturity in their native habitation: and as nature does nothing in vain, it would be arraigning the protecting hand of Providence to imagine that seeds would be produced in any plant, if the seeds of that plant were not in some instances necessary for preserving its existence. We are too apt to limit our observations to the period of our own existence, without remembering that many parts of the created world may possess a duration of life immensely more extended than the life; and because we do not see them perish with ourselves, are apt to think the production of seed is not necessary for the preservation of the species, but that it may be continued to the latest period of time by slips and cuttings, which are merely amputated limbs of the parent plant, and not a new generation; it is therefore a fair conclusion, that they should decay, perish, and die, with the original stock; whereas a new generation raised from seed commences its existence from a new epoch. Mr. Knight has shewn this to be the case with respect to the golden pippin and the golden rennet, two kinds of apple highly valued and commended by our ancestors, but now fast verging to decay.

Mr. Cartwright's remarks on dressing potatoes are highly deserving the attention of every one; the necessity of improvements in the culinary process of preparing vegetables for the table is generally admitted, and the suggestion of this gentleman to take the potatoes out of the water before the ebullition ceases, is a sufficient remedy for any deleterious quality which the aqueous part of them may be supposed to possess. Though much useful information with respect to the culture of the potatoe is not to be learned from this essay, yet much that is known is placed in a new light, and new paths are pointed out for obtaining a perfect acquaintance with this valuable root, "which," says this writer, "had its properties been known to the Egyptians, they would probably have consecrated it as their principal divinity, not only on account of its important application to human life, but as a symbolical instance of the mysterious obscurity of nature in the generative process, to which their mythology is perpetually allusive, and as an emblem of fecundity."

Account of the Moss Improvements of JOHN WILKINSON, *Esq. of Castlehead, in Lancashire. By Sir* JOHN SINCLAIR, *Bart.— Communications to the Board of Agriculture.* Vol. v.

CASTLEHEAD is situated on that arm of the sea which divides the district called Furness from the rest of Lancashire. The sea overflows an extensive tract of country, and the appearance denotes that a spirit of improvement could only have been recently introduced into it. The roads are in some places very steep, going over the ridges of hills, instead of being conducted round them. Large tracts of moss land are seen in a state of nature. The fields, whether inclosed for grass, or cultivated by the plough, are in much the same state as a century ago. Such is the nature of the country where Mr. Wilkinson has made his improvements. He was originally induced to think of acquiring property there, with a view of making iron from the peat, with which that country abounds; but he was deterred from proceeding with the manufacture by the many disadvantages which surrounded him; and he considered whether the soil could not be made capable of cultivation.

The nature of the moss was most discouraging: it was of the kind which in Scotland is called *flow moss*. About five feet of it consisted of a soft spongy light kind of peat; below that was a black stratum of very excellent quality, and of great depth, in many places more than 15 feet, and the bottom was a strong blue clay, unfriendly to vegetation till it had been ameliorated by the atmosphere. Its value, except for fuel, was inconsiderable; and the offer of pasturage upon it at three-halfpence an acre had frequently been rejected.

An attempt was made to improve part of this tract in 1778, when some general drains were made, but, being cut at too great a distance, the moss was not rendered sufficiently dry; the surface was breast-ploughed and then burnt; but this plan did not answer. It became necessary therefore to make a new attempt, which is described in this communication. It was, in the first place, found necessary to make a sufficient number of large open drains, both to carry off the stagnate water, and to promote a consolidation of the moss; also he covered small drains, made with sods, which have been dried for about three weeks, or more, according to the season. In soft spongy moss the covered drains ought to be at first nine yards distance, and, when the moss is consolidated, covered drains must be made, first between, and afterwards across the covered drains that are first made. Next to drains, roads were found essential, and Mr. Wilkinson has been very successful in making them good over the softest moss. The instruments used were a *tom-spade* for cutting the drains, a

swing-plough with a steel coulter, very sharp, and an instrument for cross cutting the surface previous to its being ploughed. The only peculiar instrument is a *horse-patten*, to be used when the moss is soft, which is a machine of a circular form, adapted as well to be affixed to the hind as the fore-feet of horses; it has a wide flat surface at bottom, and causes the pressure of the horses' weight to be extended over a much larger surface of the spongy soil. Before this invention, the ploughs were worked by the strength of men till the moss had consolidated.

With respect to rotation of crops, the following plan was pursued after the draining and other previous operations had been completed, before the lands could be laid down to grass. In the first year the heath was burnt and the moss ploughed seven inches deep, and then covered with clay, or sand, or mould, as any of these articles were most convenient; and afterwards it was sown with turnips. The second year, after a slight ploughing, oats were sown. The third year another slight ploughing was given, and any remaining clods were burnt, and the whole again sown with turnips. In the fourth, and sometimes again the fifth year, oats were sown, and grass seeds with them to remain; or the grass seeds were sown with a winter crop of rye, and well rolled in. Thus the land was brought into grass in perfect good order, and may be pastured with much advantage for five or six years, when the same process may be repeated without disturbing the drains. The expense of this improvement must certainly depend on circumstances, but may be estimated at about 14*l.* per acre. Mr. Wilkinson has already improved, or is in the course of bringing into cultivation, no less a quantity than about five hundred Lancashire acres (each about 1 acre 3 rods statute measure) of this kind of soil, which will be worth to let at from 30s to 40s per Lancashire acre.

Such is the substance of the information which Sir John Sinclair has communicated concerning this great improvement, which, considering the unproductive nature of the moss, the expense necessary to improve it, and the success with which it has been attended, can, in his opinion, hardly find a parallel in any part of the united kingdom.

Observations.—From this communication, Mr. Wilkinson appears in a light no less laudable as an agriculturalist than he has long done as a manufacturer. The example which he has set of improving the mossy wastes of Lancashire, are highly deserving the imitation of the landed interest of that county, which is equally populous and less productive than any other county in England. Though Mr. Wilkinson has not been successful in his attempts, yet the idea of making iron from peat ought not to be entirely relinquished, as it may answer in some places where labour is cheap, and the climate drier than Lancashire. The in-

vention of a patten for horses, to make their feet press upon a larger portion of ground than they would otherwise do, is a very ingenious contrivance; and is capable of very extensive application in the improvement of morasses. There is little doubt, but that much of the swampy land, which yet remains in England, might be brought into cultivation, if its improvement were attempted with the same persevering industry as this gentleman has displayed on the moors in Lancashire.

Account of the Improvement of more than Ninety Acres of Land, lying waste. By Mr. PHLLIPS, *of Tyn-y-Shos, near Oswestry.—Com. to the Board of Agriculture,* Vol. v.

A LARGE quantity of waste land in North Wales was divided by agreement in 1804, a part of which became the property of the farmer who made this communication. The first piece on which he begun his improvements was an allotment of eight acres of moist land, which produced a coarse sour herbage. He fenced it with a four feet ditch, with a double rail at the top, and planted a row of quick on the top of the ditch, to become a fence when the rails decayed. The surface soil was about six inches deep, with a substratum of bad yellow clay. He ploughed it first in June, 1804; cross-ploughed and harrowed it in August; ploughed it a third time the end of September, and manured it with lime, 211 bushels to the acre. He ploughed it again in October, in small ridges, and sowed it with corn, which was harrowed in. About three bushels of wheat was sown upon an acre. The ridging was peculiarly necessary to carry off the water. The produce was 30 bushels per acre: the expenses amounted to 88*l.* 19*s.* 1*d.* and the wheat was worth 130*l.* yielding a profit of 5*l.* 2*s.* 7*d.* per acre. The load in its natural state was not worth five shillings an acre; but he thinks, when it is laid down to grass, it will be worth forty shillings an acre. In the beginning of October 1805, the stubble was harrowed off, and another crop of wheat was obtained as excellent as the foregoing. As he thought that old common land could not easily be exhausted, he was tempted to sow a third crop of wheat in 1806, which, at the time of making the communication, promised to be equally productive.

Another close of land, of 21 acres, was situated on a mountain so steep, that no waggon or cart could be used to carry off the crop, so that a drag must be employed for this purpose. This piece was ploughed in December, with very great expense and labour, harrowed in the following June, crossed in July, and manured in August with lime, 250 bushels to the acre. The lime was carried in small quantities, and laid upon the land with the assistance of three men to each team, which was necessary on

account of the unevenness of the ground. It was ploughed again in October, and sown with wheat at the rate of three bushels to the acre, and the crop was very promising when this account was written.

A third field had a south-east aspect, and the situation was much higher than that last-mentioned; he inclosed it with a ditch, in which he planted hawthorns. This was first ploughed in February 1805, harrowed the next June; ploughed a second time in July, harrowed again in September, and limed with 270 bushels to the acre. In October it was sown with wheat, three bushels and a half to the acre, which came up in abundance, and looked as healthy and promising as any crop in the country. Mr. Phillips has always remarked, that on such light soils as are here described, it is necessary to sow a larger than usual quantity of seed by the acre.

A fourth allotment he fenced in part with a stone wall, and the remainder with a ditch faced with stone, and a single rail above. This was light and fresh land, and he sowed in it oats without manure, and with one ploughing. The first appearance of the oats was so bad, that he thought it best to throw some lime upon the land; he therefore manured eighteen acres where the oats were sown, and part of that sown with beans and peas, with 230 bushels of lime to the acre. The return of oats was twenty bushels per acre; the peas and vetches produced but a poor return. In November this land was ploughed up again, and sown with wheat which promised a good crop.

He has several other allotments, which his success upon those above-mentioned, has determined him to cultivate immediately; and a few acres of steep ground, which are incapable of cultivation, he had resolved to plant with different kinds of forest trees the last spring.

Observations,—This account of improvements in the mountainous country of North Wales is extremely interesting, from the energy with which it was undertaken, and the judgment with which it was conducted. Every rational agriculturist must, however, enter his serious protest against three successive crops of wheat in the same field, which is a practice ruinous and destructive to the richest soil. Mr. Phillips does not appear to have repeated it; and he seems, from his subsequent management, to have been sensible of his error. By the debtor and creditor's account of his improvement (annexed to the communication) he appears to have reaped considerable advantage from this employment of his capital, which, though it may appear large in the eyes of many, is yet not more than his industry and enterprising spirit fully merited. His improvements are worthy of being imitated in all mountainous districts.

HORTICULTURE.

Hints respecting the proper mode of inuring tender Plants to our Climate.—By the Right Hon Sir Joseph Banks, *Bart. Horticultural Transactions*, Vol. i. Part I.

No branch of the horticultural art is represented to be more respectable in itself, more useful to the public, or likely to prove more advantageous to those who may succeed in it, than that of inuring the native plants of warmer climates, to bear without covering the ungenial springs, the chilly summers, and the rigorous winters of Britain. Though many valuable shrubs, which used to be kept in stoves, are now found in the open garden, yet Sir Joseph Banks thinks there is reason to believe that every one of these was originally the native of a cold climate, though introduced to us through the medium of a warm one. He believes it probable that much has been done by our ancestors in the case of annuals, and something by the present generations; but he wishes it to be remembered, that all which is required in the case of an annual, is to enable it to ripen its fruit in a comparatively cold summer, after which the severest frost has no power to injure the seed; but that a perennial has to encounter frosts with its buds and annual shoots, that have sometimes been so severe as to rend asunder the trunks of our indigenous forest trees, of which Millar, in his dictionary, has recorded many instances. He conceives that wheat, our principal food at present, did not bring its seed to perfection in this climate till hardened by repeated sowings, and in confirmation of his opinion, instances some spring wheat from Guzerat, which a few years ago was sown by him with barley in a well cultivated field; it rose, eared, and blossomed, with a healthy appearance, but few ears brought more than three or four grains to perfection. He then gives an account of an experiment with the Zizania aquatica, which proves that an annual plant, scarcely able to endure the ungenial summer of England, has become in fourteen generations as strong and as vigorous as our indigenous plants are, and as perfect in all its parts as in its native climate. It is related that in the year 1791, some seeds of the Zizania aquatica were procured from Canada, and sown in a pond at Spring Grove, near Hounslow; they grew and produced strong plants, which ripened their seeds; those seeds vegetated in the succeeding spring, but the plants were weak and slender, and not half so tall as those of the first generation: the seeds of these produced others the next year sensibly stronger than the parents of the second year; and in this manner the plants proceeded, becoming every year stronger and

stronger, till in 1804 several of the plants were six feet in height, and the whole pond was in every part covered with them. He proceeds to remark that some of our most common flowering shrubs have been long introduced into the garden; the bay tree has been cultivated more than two centuries; the laurel grew at Hampstead some years before 1629; and at that time there were in our gardens oranges, myrtles, laurenstinus, cypress, phillyrea, alaternus, and arbutus; and though near two centuries have since elapsed, not one of them will yet bear with certainty our winter frosts, and, that though some of these shrubs ripen their seeds in this climate, it has never been the custom of gardeners to sow them; some being propagated by cuttings and suckers, and others by imported seeds, the former being only different parts of the individual originally introduced, and the latter of only one year's growth in this climate, and the divisions of it From these premises, he concludes it to be no wonder that these original shrubs have not become hardier, though probably they would have done so had they passed through several generations of British seeds: and observes, that the experiment on the Canadian Zizania, not only corroborates this inference, but also points out the method of naturalizing other plants and tender shrubs by sowing the seeds of such as occasionally ripen in this climate; for though it required fourteen generations to produce the Zizania as perfect as in its native country, yet a considerable improvement in hardiness was manifested at every remove from the original seed; and he apprehends that a much less number of generations will be sufficient to attain the desired end in many instances; and though the habit of hardihood fitted to this climate should not be complete, he thinks every progress towards it desirable, and believes that even one generation may work a change of no small importance. If we could make the myrtle bear the climate of Middlesex as well as it does that of Devonshire, or exempt our laurel hedges from the danger of being cut down by severe frosts, he should consider it an acquisition of no small consequence to the pleasures of the gentleman, as well as to the profit of the gardener. Notwithstanding his advanced period of life, he declares his intention of commencing experiments himself on the myrtle and the laurel, and strenuously exhorts his younger brethren of the Society to take measures, for bringing to the test of experiment, the theory which he has ventured to propose.

Observations.—The many years which Sir Joseph Banks has spent in observing and examining the various operations of nature, in the vegetable as well as the animal kingdom, give a weight to his opinions, which would scarcely attach to those of any other writer. The theory laid down in this paper respecting the proper mode of inuring tender plants to our climate is very ingenious; and the reasonings, by which it is supported, are strictly philosophical. It

rests, however, on the result of a single experiment only, that of the zizania, in which it has been completely verified. But it must be remembered, that the zizania is produced spontaneously in Canada, in a parallel of latitude as northern as our own. It is true, that our summers are not so intensely hot as those of Canada; neither are our winters so severe: vegetation is less luxuriant in the spring at London than it is at Quebec; but the average temperament of the one climate is not materially different from that of the other. The experiment of the zizania then ought not to be received as conclusive evidence of the truth of the theory, that tender plants may be universally inured to our climate, by sowing the seeds which they ripen here year after year; but still it tends to shew the probability of the thing, and offers a powerful inducement to resort to other experiments of a similar kind. It has been very judiciously observed by Mr. Knight, in his remarks on the objects which the Horticultural Society have in view, that the propagation of a tree, by cuttings or suckers, is only causing the separate existence of a part of the individual plant; and Sir Joseph Banks has adopted this opinion as his own in the paper now under consideration: it is evident, therefore, that tender plants, which were propagated only by cuttings or suckers, could not reasonably be expected to become inured to the climate merely by continuing in it a considerable number of years, for they may all be identified with the original parent plant; and both experience and the united testimony of all horticulturists agree in shewing that they have not become so. On the contrary, seedlings retain none of the properties of the parent, but the specific character; they sport, as Mr Knight expresses it, in endless variety. It has been proved, that not only new, but also superior kinds of fruit have been produced by plants raised from seed; and that flowers are frequently improved in beauty and fragrance by the same method. Why then is it not equally reasonable to conclude, that a variety of any plant may be obtained by the same means, which shall be better adapted to our own climate? The change having been proved in a Canadian plant, though it must be rejected as a decisive proof, certainly affords a strong presumption that the same cause will produce the same effect in a plant which grows spontaneously in another climate; and if in a plant from one other, why not in plants from all? The experiment is easy; it is within the reach of every man who possesses a garden; and if Sir Joseph Banks is stimulated to attempt the experiment in his advanced stage of life, now he is full of years and honours, what excuse can the young horticulturist have for omitting to make those experiments, which may be at the same time advantageous to himself and honourable to his country.

On the Cultivation of the Crambe Maritima of Linnè, or Sea Kale. *By Mr.* JOHN MAKER. *F.H.S.—Horticultural Trans.* Vol. i. Part 1.

THIS plant is found on many parts of the sea coast of England, particularly on the north coast of Norfolk; and also near Fastcastle in Berwickshire; sandy shores are its natural soil. The whole plant is smooth, of a beautiful glaucous hue, covered with a very fine meal; occasionally, however, it varies like the wall-flower-leaved ten-weeks stock, with quite green leaves. It was known and sent from this country to the continent, more than two hundred years ago, by L'Obel and Turner, but Millar was the first who wrote upon it professionally, as an esculent, stating in his first edition of his Gardener's Dictionary, published in 1731, that the inhabitants of Sussex gather the wild plants to eat in spring, soon after the heads are thrust out of the ground, otherwise it will be tough and rank. Professor Martyn gives some valuable instructions for the cultivation of this plant, in his edition of Millar's work, and the late celebrated Mr. Curtis has recommended it, and diffused the knowledge of it, in a dissertation on the subject.

To grow this vegetable in the highest perfection, it is recommended to prepare the ground in December and January, by trenching it too feet and a half deep; if not that depth naturally, and light, it must be made so by adding a due proportion of fine white sand, and very rotten vegetable mould; and if it be wet in winter, it must be effectually drained, so that no water may stand within a foot at least of the bottom; for the strength of the plants depend on the dryness of the soil. The ground should be divided into beds four feet wide, with alleys of eighteen inches between; after which, at the distance of two feet each way, let there be sown five or six seeds in a circle of about four inches diameter; this operation must be performed with strict care and regularity, as the plants are afterwards to be covered with blanching pots of about eighteen inches diameter; and both the health and beauty of the crop depends upon their standing at equal distances. If the seeds are good, the young plants will appear in May or June; and when they have made three or four leaves, it is proper to take away all but three of the best plants from each circle, planting those pulled up (which by a careful hand may be drawn with all their tap root) in a spare bed for extra-forcing, or to repair accidents. The fly and wire-worm are to be guarded against with the greatest caution, for they are very inimical to the plants when young; and the beds should be plentifully watered, if the months of June and July prove dry. In the following November, the leaves should be cleared away, as soon as they are decayed, and the beds covered an inch thick, with fresh light earth and sand,

which has been turned over at least three times the preceding summer, and has been kept scrupulously free from weeds ; and upon this dressing of sandy loam, there should be thrown about six inches depth, of light stable litter, which finishes the business of the first year.

In the spring of the second year, when the plants are beginning to push, the stable litter is to be raked off, and a little of the most rotten dug into the alleys, and another inch in depth of fresh loam, and sand added. It is desirable to abstain from cutting this year, though some of the plants will probably rise very strong. The beds ought to be treated the succeeding Winter, exactly as before.

The third season, a little before the plants begin to stir, the Winter covering is directed to be raked off, and an inch in depth of pure dry sand or fine gravel to be laid on. Each circle of plants is then to be covered with a blanching pot, which is to be pressed very firmly into the ground, so as to exclude all light and air; for the colour and flavour of the Sea Kale is greatly injured by being exposed to either. Let them be examined from time to time, cutting the young stems, when about three inches above ground, carefully, so as not to injure any of the remaining buds below, some of which will immediately begin to swell. In this method a succession of gatherings may be obtained for six weeks, after which the plants should be uncovered, and their leaves suffered to grow, that they may acquire and return nutriment to the root for the next years buds. When seeds are not wanted, the flowers ought to be nipped off with the finger and thumb as long as they appear. The expense of blanching-pots may be avoided by covering the beds with a large portion of loose gravel and mats, but the time and trouble of taking away the gravel from about the plants to cut the crop, and replacing it, is so great that there is no real economy in it.

Sea Kale is stated to be remarkably well calculated for forcing, for it may be forced into vegetation with very little expense and trouble; the only thing necessary is to be very particular in guarding against two much heat, keeping the temperature under the blanching pots as near as possible to 55 degrees of Farenheit's thermometer, and never suffering it to exceed 80 degrees. For this purpose, stable dung should be laid on the beds in November, and closely pressed down between the blanching pots: the crop will be fit to gather in about three weeks or a month from first applying the heat; but so much injury accrues to the plants from violent heat, that it is more desirable to begin earlier, and apply the heat in a smaller degree.

Observations.—The constant attention which Sea Kale requires in covering and earthing up, and uncovering, will always prevent it from becoming an object of general cultivation, and the necessity

necessity of covering the beds, with stable litter, to preserve it from the frost, will always exclude it from being cultivated, by those who wish to preserve neatness in their gardens during the winter, as well as during the summer months, it is however a very desirable esculent, where there are conveniencies and opportunities for attending to it. It is equal, in the opinion of most, if not superior to asparagus, and may be obtained in those winter months, when the garden produces scarcely any vegetable for the table. The directions, for its cultivation are mostly taken from Mr. Curtis's pamphlet, and indeed the writer acknowledges himself indebted to that excellent gardener for the first information he obtained respecting this esculent. It is not known when it was first used as a culinary plant, for on many parts of the Sea-coast the inhabitants have been in the practice of seeking for it in the spring when it grows spontaneously; they remove the sand and pebbles, from round the root, and cut off the young shoots close to the ground, being found sufficiently blanched by the covering of the sand and pebbles. It was probably first cultivated for sale in Sussex; for Mr. Curtis relates that Mr. William Jones of Chelsea, informed him that he saw it exposed for sale in Chichester market as early as the year 1753. It is now very generally cultivated by the nobility and gentry, who employ a gardener constantly, as well as by those persons who supply the London markets. This delicious vegetable will amply repay the time and trouble bestowed upon it, where a gardener is regularly employed, but will disappoint the expectations of those who rely upon contingent care, and fortuitous attendance for the cultivation of it.

On a Variety of the Brassica Napus, or Rape, which has long been cultivated on the Continent. By Mr. James Dickson, *F. L. and H. S.—Horticultural Transactions,* Vol. i. Part I.

The vegetable which is known in this country by the name of French turnip, is truly stated by Mr. Dickson to be only a variety of the Brassica Napus or common rape, though it has been rendered in France and Germany so mild and palatable by cultivation, as to be preferred to the common turnip; and in those countries, few great dinners are served up without it in one shape or other. The time of its coming into common use there has not been ascertained, but it is mentioned by Gasper Bauchin in 1671, as well known at that period. For above twelve years, Mr. Dickson has seen this plant brought to Covent-garden market, but only by one person, where it is chiefly sold to foreigners. He thinks, if it were generally known it would be an acceptable root in most families, for it is more delicate in flavour than the common turnip, and is to be used in the same manner. It is used in Germany

for enriching soup, and there is no necessity to cut away the outer skin or rind, but only scrape it: stewed in gravy it forms an excellent dish, and being white and of the shape of a carrot, when mixed alternately with these roots in a dish it is very ornamental. A great advantage attending the cultivation of it, is, that it requires no manure, and any light poor soil, especially if sandy, suits it; for though it seldom exceeds the size of a man's thumb in this kind of soil, yet it is much sweeter and better in quality than in manured earth, where it grows larger. The season for sowing the principal crop, is stated to be from the middle of July to the end of August: if the season should prove dry, it will be necessary to water the beds regularly till the plants have got three or four leaves, otherwise they will be destroyed by the fly: and this crop will supply the table till April; for a succession of this vegetable, the seed should be sown in October, though it be then in danger of miscarrying; and if more be sown between the middle of January and the middle of February, the roots will come in for July and August: they may, with care, be obtained on a north border through the whole summer. In order to obtain good seed, it is recommended to transplant some of the finest roots in February or the beginning of March, placing them two feet asunder, and keeping the ground repeatedly hoed: when the seed pods are formed, they should be guarded from the birds, and as soon as they change colour, the heads should be cut and spread to dry in the sun, after which the seeds may be beaten out and laid up for use.

Observations.—The utility of cultivating the Brassica Napus, or French turnip, especially to the poor, must be universally admitted, for it is an exceedingly nutritious vegetable, and is productive at that season when few other esculents can be obtained without great care and attention. As it requires no manure, the cottager may obtain it in as high perfection as the rich gardener, and he will find it improve both the flavour and nourishing qualities of his soups and broths more than any other production of his garden. Nature has undoubtedly done much in furnishing us with a variety of esculents spontaneously, and when we aid her efforts to befriend us by industry on our part, she never disappoints us; a limit is scarcely affixed to the improvement of vegetables by cultivation, and there are few which are more deserving of attention than that which is the subject of this paper. Three receipts for dressing this vegetable are subjoined to the account of it, which are said to have been received from an eminent *French* cook, but as they are all calculated to make an expensive dish of the roots with wines and gravies to be eaten *without* meat, we do not think it necessary to transcribe them for the benefit of our *English* readers.

CHEMISTRY AND MINERALOGY.

Theory of the manufacture of Sulphuric Acid. By Messrs. DESORMES *and* CLEMENT. —*Ann. de Chim. No.* 177.

IT has been supposed that the utility of adding saltpetre in the manufacture of oil of vitriol from sulphur, arose from the high temperature that its deflagration produced, and which determined the formation of sulphuric acid. Nevertheless it is customary to add also clay which tends to diminish the heat by rendering the combustion slack, and also water which absorbs during its conversion into steam a considerable proportion of the caloric. It is also well known, that sulphur by itself, even when burnt at a temperature of 1000° Cels. does not yield any sulphuric acid.

Others have supposed that the nitrate supplies the necessary quantity of oxygen which is required to finish the combustion begun by the atmospheric air; but it is easy to shew that the oxygen contained in the nitre is not sufficient to convert all the sulphurous acid gas into sulphuric acid. According to Davy, nitrate of potash contains 30 per cent. of nitric acid, which itself contains 70 per cent. of oxygen, so that the nitrate only contains 21 per cent. of oxygen. Sulphurous acid contains 59 of sulphur and 41 of oxygen, and sulphuric acid contains 52 of sulphur and 48 of oxygen. It is absolutely necessary to add 1-9th. of saltpetre to the sulphur, so that operating upon 90 of sulphur and 10 of saltpetre, we ought to obtain 152 of sulphurous acid, which would again produce 173 of the sulphuric, by the addition of 21 of oxygen: now the 10 of nitrate can only furnish 2.1 of oxygen, i. e. 1-10th of the necessary quantity. Some manufacturers add indeed 1-5th of saltpetre, but even then it could only furnish 10·55ths of the necessary quantity of oxygen, to convert the sulphurous acid into the sulphuric. It is remarkable that the quantity of acid in the residual sulphate of potash contains more oxygen than the saltpetre could furnish.

Others have supposed that the water added to the mixture was decomposed, but as the two preceding theories are those that were the most probable; it is not necessary to consider any others.

When the usual mixture of sulphur, saltpetre and moistened clay is burned, in the usual apparatus, we find that the nitric acid is not entirely decomposed, but that a great deal of red nitrous acid gas passes along with the sulphurous acid into the leaden chambers, mixed with water in vapour, and some azote, which is the residuum of the atmospheric air. We may also conjecture that some oxygen is present, having escaped from the action of the sulphur; but this although likely is yet doubtful. Now when

nitrous acid gas is mixed with sulphurous acid gas, the former is decomposed, and the latter is converted into sulphuric acid. This then takes place in the chambers, the water also b coming condensed absorbs the sulphuric acid, and caus s a vacuum into which the remaining gases rush in whirlwinds, and thus their reaction upon each other is facilitated by the motion.

After this first production of sulphuric acid, there will remain nitrous oxide gas, sulphurous acid, and atmospheric air, which has lost some of its oxygen. The nitrous oxide is converted into its acid, which is immediately decomposed by the sulphurous acid; and thus the operation proceeds continually until all the sulphurous acid is converted into sulphuric, or until all the oxygen of the atmospheric air is exhausted.

The production of sulphuric acid is quickest at first, from the motion excited by the condensation of the water, and it is also slackened towards the end of the operation by the residual azote removing the active particles farther from one another, and thus impeding their union.

When all the sulphurous acid is converted into sulphuric, the remaining substances are a considerable quantity of azote, nitrous oxide (gas or nitrous acid, if the quantity of oxygen was greater than is required for the conversion of the sulphurous acid into the sulphuric) and perhaps some oxygen, if there was more than is necessary for the formation of the sulphuric and nitrous acid.

The quantity of the base of nitrous acid is probably a little less than the saltpetre would have yielded originally as some of the nitric acid was perhaps entirely decomposed, notwithstanding the temperature is kept low by the moisture present. This base of nitrous acid taking the oxygen from the atmospheric air, and merely applying it to the sulphurous acid is a convenient form for union.

The water is no otherwise necessary, than to disengage the nitrous gas from the sulphuric acid, that it may again combine with the oxygen of the atmosphere, and be again decomposed by the sulphurous acid. The steam also produces a movement in the gases which accelerates their union.

The only supposition here made is the existence of a portion of uncombined oxygen after the air has passed over the sulphur. But the truth of this explanation is evident from considering the action of the gases when they are introduced ready formed into transparent vessels. If sulphurous acid gas and air are introduced into a receiver, and a quantity of nitrous oxide gas is added, about equal to about 1-20th the weight of the sulphurous acid. The nitrous gas immediately becomes red, and expands through the whole vessel; white clouds succeed, which are deposited on the sides in brilliant crystals. The mixtures then clear up, and if a little water is added, the crystals dissolve with a great increase of temperature, the nitrous oxide gas is disengaged, and the same phe-

nomena succeed until all the oxygen is expended, or all the sulphur combined. After the operation the colour of the nitrous acid remains in all its force, the smell of the sulphurous acid is lost, much azote remains, and oily sulphuric acid lines the sides of the vessel.

If too much water is present, or if it be mixed too intimately with the gases, the operation is slow and incomplete, because liquid nitric acid is formed, which has less action on the sulphurous acid.

It sometimes happens, that the decomposition of the nitrous acid gas, produces oxidule of azote; this appears to arise from the too great action of the water upon the gas, and it is to this that Berthollet and Morveau attribute the ill success of the process, when the water is too intimately mixed with the gases.

This theory of the formation of sulphuric acid, by one operation from sulphur, may afford hints for perfecting the apparatus,

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On the Analysis of Sweat, on its acid, and on the acids of Urine and Milk. By Mr. THENARD.—*Ann. de Chim.* No. 177.

THE maximum production of sweat appears to be 32 grains per minute, and its minimum to be eleven grains.

Mr. T. collected the sweat he examined, by elixiviating with hot water, flannel waistcoats, which, after being well washed, had been worn ten days. The ley thus obtained, was evaporated to the consistence of a syrup. As this appeared on some trials to contain acetous acid, he collected a fresh portion, by means of flannel, slightly impregnated with alkali, and after evaporation distilled it with phosphoric acid. The liquor that came over had the smell of vinegar; it formed with pot-ash a salt in small brilliant micaceous scales, sharp tasted, very deliquescent, and which exhaled a strong odour of acetous acid, by the addition of sulphuric, or phosphoric acid. This salt also precipitated nitrate of quick-silver in brilliant scales.

Mr. T. concludes, from this, and his other experiments, that the sweat of the human subject is composed of much water, uncombined acetous acid, muriate of soda, a minute portion of phosphate of lime and of oxide of iron, and an inappreciable quantity of animal matter, somewhat resembling gelatine.

The acids which are found uncombined in urine, have usually been supposed to be the uric, the benzoic, and the phosphoric; but the existence of the latter is doubted by the author, and he found by experiments founded on very ingenious reasons, that the uncombined acid which reddens tincture of litmus, when benzoic acid is not present, is really the acetous.

The author has discovered that the milk of the human female, constantly reddens tincture of litmus. To discover the nature of

the acid which produced this effect, he proceeded in the same way as that by which he detected the nature of hitherto mistaken uncombined acid in urine; namely by evaporating the milk to dryness, treating the residuum with barytes water to saturate the acid, again evaporating it to dryness, then treating the residuum with alkohol to dissolve part of the extractive matter, and to dispose the cheesy matter not to be taken up by the subsequent affusion of water, the water solution was then separated by filtration, and decomposed by phosphoric acid; when acetous acid was found in the receiver.

Mr. T. also supposes that the acetous acid is found in cantharides, and that it is very common in nature, as its principles have such a tendency to unite, that it is formed in almost every change that takes place among the principles of organized bodies.

On Orpiment and Realgar. By Mr. THENARD.—*Ann. de Chim.* No. 177.

VARIOUS opinions have been held concerning the nature of orpiment and realgar; they have been supposed to be combinations of sulphur and oxide of arsenic in the same proportion, and that their difference in colour arose from the different degree of heat to which they had been subjected; this opinion was founded upon the fact that when sulphur and white arsenic were sublimed together, the products were orpiment as well as realgar. As much more oxide of arsenic was obtained by the analysis of orpiment than from realgar, it was supposed by Bergman that they were sulphurated oxides of arsenic with different proportions of the component parts. A third set of chemists to this diversity of proportions added the greater or less oxidizement of the arsenic, as they imagined that when a metallic solution was precipitated by a hydrosulphuret the sulphuretted oxide that is formed is always of the same colour as the oxide itself.

Proust thought that when sulphuretted arsenic was treated with potash, and then precipitated by an acid, the hydrogene which is disengaged, disoxidized the arsenic by forming water, while the sulphur re-united with the metallic arsenic, and produced orpiment. The same effect takes place he thinks, when oxide of arsenic is dissolved in hydrosulphuret of potash, and an acid afterwards added, for orpiment is precipitated without the disengagement of any gas. But sulphuretted hydrogene may exist, in orpiment or it may contain an oxide containing less oxygen than white arsenic.

Orpiment flung on burning coals, swells more, and yields more sulphurous acid gas than realgar. In close vessels they are both sublimed unaltered; sulphur melted with realgar produces orpi-

ment, and orpiment melted with metallic arsenic produces realgar; sulphuric acid acts more on orpiment than on realgar, and produces with the former more sulphuric acid, and less arsenious acid than with the latter. They both decompose nitric acid without heat; orpiment yields by this means more sulphur and less arsenious acid that realgar. The same phenomena takes place with nitromuriatic acid, and oxygenized muriatic acid.

Both potash and soda speedily dissolve orpiment or realgar; hydroguretted sulphuret of potash, and arsenic of potash are formed; lime-water poured into this solution throws down a white precipitate, which being treated with carbonate of potash, and then with muriatic acid, yields plenty of arsenious acid.

Arsenious acid, distilled with sulphur yields at first sulphurous acid gas, when that is no longer produced, orpiment or realgar sublimes; so that it is probable that these contain little or no oxygen. But when arsenious acid is reduced, even by hydrogene, no intermediate stages of oxidizement take place, and therefore it is probable that none exists; and indeed by subliming together 3 parts of sulphur, and 4 of metallic arsenic, orpiment is formed; and by subliming 1 of sulphur, with 3 of arsenic, realgar. This melts at a low temperature, and remains liquid after the vessel is taken from the fire. The sublimed orpiment is transparent and hyacinth-colour, so that is has been taken for realgar. but by pulverization it becomes of a very fine yellow colour. Orpiment formed in the moist way by passing sulphuretted hydrogene through arsenious acid, or by the mixture of a soluble arsenite, a hydrosulphuret and an acid, is of the usual yellow colour. Hence it is probable that native orpiment is formed by the moist method, and that some varieties which have been exposed to heat, are of a hyacinthine colour and have been mistaken for realgar. This latter seems to be formed by fusion.

Continuation of a Paper on Coffee. By Mr. Paysse.—*Ann. de Chim.* No. 177.

In our last volume, p. 501. we gave an account of Mr. Paysse's former paper on coffee, in which he pretended to have discovered a new acid, namely, the coffic; the object of the present is merely the best method of preparing coffee, and the substitutes adopted in Holland instead of it.

The French are very careless in roasting their coffee, and many reduce it almost to a coal, which produces a high coloured, but disagreeable decoction. In Holland they use greater care, and roast it only till it is of a uniform, and clear brown colour; some add a little butter or sugar. The Java coffee is that which furnishes the greatest quantity of those oily globules on the surface of the

prepared liquor, which are esteemed a proof of the goodness of coffee.

The Dutch and Flemings do not boil their coffee, but only infuse it in hot water, and in a close vessel, by which means they obtain a much finer liquor. The decoction being always turbid, and when clarified, as in France, with isinglass or white of egg, the oily matter is equally drawn down; filtration indeed has not this effect, but the superior quality of the infusion, renders that process far preferable; and this more especially, because the extractive matter of vegetables, is decomposed by exposure to the air, so that the decoction of coffee by long boiling, loses much of its colour. But instead of the flannel bags, in which the coffee is usually put, it is better to employ a tin vessel pierced with a number of very small holes.

The Dutch make great use of the roots of blue succory, (cichorium intybus, Linnæi) as a substitute for coffee. They are collected in spring, washed, and cut lengthwise into 4 or 6 slices; these slices are cut transversely by a machine, similar to that by which straw is cut for horses, and are afterwards dried upon a kiln, heated to about 45 or 50° Cels. These kilns are usually kept closed, but this seems to hinder the drying. The dried roots are then roasted, and afterwards ground to powder. In the roasting it is usual to form three different shades of colour, by extending the process to a greater length of time. At first they only mixed this roasted root with the true coffee, to the infusion of which it gave a bitterness that was supposed to be very wholesome and refreshing, and to diminish the drying quality of the true coffee. Of late they have used the succory root by itself, although Mr. Paysse thinks it by no means comparable to the real coffee.

Besides the roots of blue succory, beans, peas, lupins, &c. are cultivated for the formation of coffee. An acquaintance of the author's having grown a quantity of beet, in order to attempt the extraction of sugar from it, according to the process of Achard, and finding it not likely to answer, converted the whole into coffee; frankly avowing that this was not his first trial, but that he had made coffee from turnips, parsnips, &c

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On Firesticks, as a Substitute for Quickmatch or Portfires. By Mr. C. L. Cadet.—*Ann. de Chim.* No. 177.

The common quickmatch is made by boiling a hempen cord of a middling strength in a ley of salt-petre, woodashes, quicklime, and horsedung. When dried, and lighted, it burns slowly, $4\frac{1}{2}$ inches lasting about an hour. But it wants to be continually unrolled off the linstock round which it is usually wound, a heavy ram extinguishes it, and as the extremity hangs dangling, the gunner is of necessity slow in his firings.

Portfires are paper tubes filled with a mixture of sulphur and saltpetre with a little powder; these burn very fast, with a vivid flame, and set fire to the priming with great ease. But in general some of the saltpetre does not burn, and runs out of the tube, and if the powder be unequally mixed, the portfires are apt to sprit, and throw out sparks to three or four feet distance, hence on board of ships they are obliged to keep them, when on fire in a tub with some water in its bottom.

Borde and Proust proposed to the Spanish government the use of wooden rods impregnated with nitrate of copper. Upon hearing of this news Mr. Cadet made a similar application to the war minister, and was desired to pursue the discovery in concert with a captain of artillery.

Different sorts of wood were boiled in a strong ley of saltpetre; the common cane was the only one that burnt freely, but its coal had no solidity, it broke off with the least shock, and of course the fire was extinguished.

On boiling different kinds of sticks in the nitrates of copper and of lead, those of oak, elm, ash, and elder, did not become saturated with the salts, and burnt in the usual manner; those of birch, poplar, lime, and fir, made very good firesticks. As the nitrate of copper is dear, corrodes the vessels in which it is boiled, and emits an unhealthy vapour, its use was abandoned; and as the fir rods were not so good as the others they also were rejected.

Rods therefore of the other kinds of wood, about $\frac{1}{2}$ yard long and $\frac{1}{2}$ inch square, were boiled in a solution of nitrate of lead, and the following results were obtained.

Woods.	The metre in length weighed before the impregnation.	After it.	A lb. of nitrate would saturate in length.	Time that the rod took in burning.
Birch - -	888 grains -	1416 grains	$17\frac{1}{3}$ metres	3 hours
Poplar - -	516 —— -	936 ——	$21\frac{2}{3}\frac{3}{7}$ ——	2 ——
Lime - -	888 —— -	1728 ——	$10\frac{3}{3}\frac{1}{5}$ ——	3 ——

Hence the lime (or linden) wood appeared to be the most advantageous.

As light is sometime required in the artillery service; Mr. C. tried the subsequent impregnation of the nitrated rods with oil of turpentine and found it not only answer the purpose, but to have also the further advantage of rendering the rods impenetrable by water, and of facilitating the reduction of the lead.

The superiority of nitrate of lead over saltpetre, appears to arise from the greater heat which the boiling solution acquires, by which the moisture of the wood is expelled; and as the salts of lead are easily reduced by the contact of a burning coal, the rods burn with rapidity; so also a rope boiled in a solution of sugar of lead, and then dried becomes a good match, it burns slowly like agaric tinder, and forms a very live coal.

It appears from the above experiments, that the lightest woods absorb the greatest quantity of saline matter; hence we may conclude that they contain a less quantity of carbone than the heavier kinds, and consequently, as it is probable, that the quantity of caloric disengaged during combustion is in proportion to the quantity of oxygen absorbed, Mr. C. thinks it is possible, by observing the quantity of saline matter that different woods can take up, to ascertain which is most proper for domestic uses, whether we require a rapid combustion, or a strong slow fire.

The superiority of the new firesticks is evident; a portfire lasts only 3 or 4 minutes, and is subject to break in carriage, and to throw out dangerous sparks; the firestick, a yard long, burns for 3 hours, is solid and not liable to be broke, or to throw out any sparks. As to the price the saving is very considerable, a portfire costs from 6 to 9 sous, i. e. about $4\frac{1}{2}$d, and the firestick from only 3 to 4 sous, i e. about $1\frac{1}{2}$d or 2d.

The firesticks have been used in the most rainy weather without being extinguished; their combustion was only somewhat slackened.

Mr. C. gives the following directions for preparing these firesticks. The wood is to be sawn into square laths $\frac{1}{2}$ metre (yard) long, and 6 lines ($\frac{1}{2}$ in.) thick. Round rods do not afford so good a point as the square laths, which are terminated when in use by a quick cone, about 2 inches long. These laths ought to be made of wood that has been at least a year in store, and moreover exposed for half a day to the heat of a stove, heated to 30°. Cels. For want of a stove, they may be put into a baker's oven after the bread is drawn.

The nitrate of lead is best prepared by putting 16 ounces of litharge or red lead into a glass vessel, and pouring it on 13 ounces of nitric acid, (i. e. aquafortis) at 40°. Beaume, mixed with 4 oz. of distilled water, the mixture is then to be heated until the solution is finished, when it is to be filtered and evaporated to dryness. It ought to yield about 20 oz. of nitrate of lead. Care must be taken that a sufficient quantity of the oxide of lead is used, otherwise the acid not being saturated will corrode the boiler.

The rods being laid in a well tinned copper boiler, the necessary quantity of nitrate is to be added, and some water in the proportion of about a quart of water to each pound of the nitrate. The rods are to be kept down under the liquor by a piece of tinned copper laid upon them; the boiling is to be continued for six hours, adding fresh water as the other boils away. When the boiling is finished, they are to be taken out, drained, and then dried in a stove.

They are then to be put into a copper, or cast iron vessel, placed upon a sand bath. Oil of turpentine is to be added until it rises about an inch above them, and the whole slowly heated until the oil boils. As soon as it becomes white, and begins to rise, the

vessel must be covered, and taken from the fire until it subsides, when it is again to be replaced upon the bath. This heating to ebullition ought to be repeated two or three times. When the oil is cold the rods are to be wiped, and finally dried again in the stove for use.

On the Alkaline substances used in Commerce. By Mr. Descroizilles, sen. — *Ann. de Chim.* No. 178.

The Editors of the Ann. de Chimie, have omitted the commencement of this rambling paper. We have ourselves abridged the voluminous title of it, and shall only give a rapid sketch of its contents.

American potash, which Mr D. chooses to call *fausse potasse*, being sometimes very dear in France, he advises the washerwomen to add a little lime to their wood-ashes, or common potash, and where salt-works exist, to add a little common salt as well as lime to the ashes, before they are elixiviated.

The use of purified soda is preferable to that of the common soda or barilla, from its uniform strength; and it may be procured at even a less price, considering the real quantity of alkali.

Mr. Carny, who is well known in France, for a remarkably expeditious process for making gun-powder, has established a manufactory of soda at Dieze, where he has made in one year 1200 cwt, and might make 2500. He sells it 1°. in very dry powder, whose alkaline power is equal to that of salt of tartar, at 200 liv. the 100 kilogrammes, (93s. the cwt.) delivered at Rouen, being only the same price as Russian potash, although 20 per cent. stronger, 2°. in lumps, 3°. in well-shaped colourless crystals.

The impurity in the common alkalies, has always rendered it an object worthy of attention to discover some easy method of appreciating the quantity of real alkali that they contain. Mr. D. thinks, that as sulphuric acid (oil of vitriol) is very common to be met with, of an uniform strength, viz. of the specific gravity of 1.844 the shortest method is to find how many hundredth parts of its weight, the alkali requires of that acid to saturae it.

To proceed in an uniform manner, he first dissolves a decagramme (154 gr.) of the alkali to be essayed in a decilitre of water, of which solution when poured off clear, he takes a demidecilitre (3 cub. in.) and adds gradually sulphuric acid previously diluted with nine times its weight of water, until the saline mixture no longer reddens syrup of violets. To obtain a ready expression of the quantities of sulphuric acid employed in this saturation, it is poured out of a graduated tube, (called by Mr. D. an alkalimeter) which contains 38 grammes of the diluted acid, and is divided, so as to shew by inspection how many half grammes ($7\frac{1}{2}$gr.) have been employed

in the saturation. For each half gramme of the diluted acid, contains a quantity of real acid equal to 1-100th of the quantity of alkali employed.

When alkaline substances which require pulverization are assayed, more should be pulverized than is absolutely wanted for the trial.

As the point of saturation can seldom be obtained exactly care must be taken to have some excess of acid, and to allow for that excess.

The following is the mean result of many thousand trials made in the course of 25 years use of the graduated tube.

Best American pearl ash . .	60 to 73
Caustic American potash, in reddish lumps	60 - 63
Second American pearl-ash . .	50 - 55
Second caustic American potash, in grey lumps	50 - 55
White Russian potash . . .	52 - 58
White Dantzic potash . . .	45 - 52
Blue ditto . .	45 - 52
Alicant barrilla	20 - 33
Natron	20 - 30
Inferior kinds of barilla and soda .	10 - 15

To which may be added the following:

Salt of tartar		72
Mr Carny's soda .	No. 1 . . .	70
	2 . . .	46
	3 . . .	36

Although the above may be considered as the mean force of these alkalies, great inequalities are sometimes found in assaying those usually sold; so that neither the consumer, nor the merchant can at present depend upon the quality being agreeable to the name by which it is sold. It would, probably, answer extremely well for merchants to assay the alkaline substances they deal in, and to sell them with a guarantee of their quality, as the trial of their force is so easy.

The graduated tube used for the measurement of the diluted sulphuric acid, may also be used for a berthollimeter. In this case the level at which the diluted acid stands, when 38 grammes are contained in the tube, is marked 18; and that when only 2 grammes are contained in the tube, is considered 0; so that the addition of 2 grammes of diluted acid is equal to one degree of the scale. But this substitute is not equal to the original instrument described in the Journ. des Arts et Manufactures, Vol. i.

Mr. D. proposes to extend the use of the instrument, to ascer-

tain quickly the strength of vinegar, &c. by using an alkaline ley of a determinate strength, in place of the diluted sulphuric acid, and a certain measure of the acid to be tried.

The super saturated carbonate of potash, which is the basis of all the potash, &c. of commerce, is an uniform salt containing 40 per cent. of carbonic acid; whereas the neutral carbonate contains 84. But it must be confessed, that some of the potash of commerce contains a rather larger proportion of carbonic acid.

The processes rendering potash caustic, differ in respect to the proportion of the species, and of the water, even in the works of the most modern chemists. 4-10ths of lime is sufficient to extract all the carbonic acid from the supersaturated carbonate of potash; but it is absolutely necessary to operate with seven times as much water as carbonate.

If 4 parts of lime, 10 of white Russian potash, and 70 of water, are boiled together for a few minutes, and when cool, water added to make up the original weight of the whole mixture: this ley does not precipitate lime water, nor effervesce with acids. If only 50 of water were originally employed, the ley effervesces with acids, and precipitates lime water, but on the addition of the deficient 20 parts of water, both these phenomena cease. Hence, we plainly see, why in common processes the second ley is sometimes caustic, although the first effervesced with acids; and also why when a sufficient quantity of water has not been added at first to the mixture of lime and potash, the addition of lime, although it was superabundantly employed, will, by rendering it necessary to add more water, cause the complete decomposition of the carbonate.

All lime prepared by a wood-fire, contains potash superficially, nor is this astonishing, since we find that the "*fine white dust*" that attaches itself to saucepans over stoves, has a decided alkaline taste; to this cause is owing the gray external appearance of quick lime. Mr. D. estimates this alkaline adulteration at about 1-500 part of the mass. This potash is probably the cause of the decomposition of a portion of muriate of soda, as stated by Scheele, as also of the dispute relative to the salt of lime, and of the superior efficacy, which has been attributed to the first infusion of lime.

Mr. D. found an efflorescence of sulphate of soda upon the plaster of a cellar under his kitchen, and carbonate of soda where the plaster was broke down. He attributes these efflorescences partly to the potash in lime and partly to the ley used for washing, which had soaked through the floor of the kitchen, and met with common salt arising also from soakage, whence the carbonate of soda was first produced, and this being decomposed in part by the sulphate of lime in the plaster formed sulphate of soda.

The natron found in Egypt, may arise from the decomposition

of common salt, by the potash yielded by the spontaneous resolution of the reeds and rushes growing on the shores of the lakes: in this case, we ought to find muriate of potash along with the natron.

Examination of the decoction of the stalks of Maize, as to the manufacture of Sugar from it. By W. Accarie.—*Ann. de Chim. No.* 178.

Fifteen lb. of bruised maize stalks were boiled in a sufficient quantity of water; the decoction being filtered was of a golden colour, and very sweet.

Solution of acetite of lead rendered the decoction turbid, and threw down a precipitate, the supernatant liquor was very clear, and its colour lighter. Acidulous oxalate of potash threw down a precipitate, and the liquor remained milky. Liquid acetite of ammonia augmented the colour but did not occasion any precipitation. Muriatic acid yielded nothing particular, the oxygenized acid threw down a slight precipitate without changing the colour: this precipitate is owing to the oxygen which uniting with the extractive matter, renders it insoluble in water. Caustic potash sulphate of iron, sulphuret of potash, and alkohol produced no effects; nitrate of quicksilver yielded a gray precipitate.

The decoction evaporated to a syrup, and exposed to a cold of 10° below freezing, for 20 days, did not yield any crystals, or even a sediment. It was diluted with 20 times its weight of water, clarified, again reduced to a syrup, and left at rest, but without any success. The syrup was then evaporated to an extract, and treated with alkohol, which dissolved one half of it. The solution was brownish yellow, and had the taste of a very sweet cordial without spice, it was not altered by water. The alkohol being separated as usual, the residuum did not crystallize, but appeared like treacle. None of the usual modes for crystallizing sugar, nor even treatment with charcoal, would bring it into crystals, although in every other respect it was similar to sugar.

The saponaceous, and slightly sweet substance left undissolved by the alkohol, was dissolved in water, and weighed, when reduced to an extract, $4\frac{1}{2}$oz. One oz. of this dissolved in nitric acid, in the manner of gum, yielded nitrous gas, and oxalic acid. The remaining $3\frac{1}{2}$oz. were incinerated. The coal was very voluminous, and very porous; the ashes weighed $\frac{1}{2}$oz. which yielded 2 gros of saline matter that appeared to be carbonate of potash, mixed with a little magnesia.

Hence it is not likely that the stalks of maize can ever be profitably employed to make sugar as they yield only 2lb. of a treacley matter, per cwt.

Chemical Observations. By Mr. Gehlen.—*Ann. de Chim.* No. 178.

When the expressed juice of ants is distilled, the white liquor that comes over cannot contain malic acid, and when it has been combined with different bases, and again separated by sulphuric acid, or other means, it does not resemble the acetic. Lowitz was not able to make it crystallize, even under the most favourable circumstances. It takes a greater quantity of any base to saturate it than acetic acid of the same specific gravity, and the salts it forms do not resemble the acetates; for example, the formate of copper is blue, crystallizes in cubes, and melts in its own water of crystallization. It forms an ether different from the acetic; and decomposes all the acetates.

Fourcroy and Vauquelin also pretend that the pyrotartaric acid is the same as the acetic; but that which is yielded by cream of tartar leaves on evaporation, brownish crystals. These crystals have been ascertained both by Mr. Gehlen and Mr. Rose not to be tartarous acid.

Lampadius has acknowledged himself, some years ago, that what was called carburetted sulphur did not contain carbone.

Klaproth made another analysis of menilite, which differs from his former one, and still more from that of Lampadius. It is now stated to contain 62.50 per cent. of silica, 8 of magnesia, 4 of oxyde of iron, 0.75 of carbone, 0.75 of alumine, 0.25 of lime, 22 of water, 1.75 being lost, On distillation, it yields a liquid that has a bituminous smell, and contains a slight trace of ammonia; carbonic acid gas, and carburetted hydrogen were emitted. It is decomposed by acids without effervescence, or loss of weight.

On a Hydrostatic Blowpipe. By Mr. Correa.—*Ann. de Chim.* No. 178.

Mr. Hare, who invented a blowpipe, the flame of which was produced by a mixture of hydrogen and oxygen, has attempted to adapt his blowpipe to the pneumatic trough, and to avoid the inconveniences of emptying and filling the trough repeatedly with water, as the level of that fluid rises and falls.

This apparatus is described in the Memoirs of the Society at Philadelphia, vol. vi. part 1. p. 99. It also appears, that by means of this instrument, globules of platina, of more than a line in diameter, have been rapidly and completely volatilized. Both native platina, and the orange precipitate, thrown down by mu-

riate of ammonia from the nitro-muriatic solution of platina, were used in these experiments with equal success.

Pure strontian, exposed upon charcoal, was also melted into a black semi-vitreous substance, of a hemispherical form.

On the distilled Water of Borage. By PHILIPPE-ANTOINE STEINACHER.—*Ann. de Chim.* No. 178.

IT is known that the distilled water of borago officinalis deposits mucous threads when it has been kept some time. But on distilling some borage with great care, and drawing off only one-eighth of the distilled water in which it had been immerged, the distilled portion was limpid, colourless, smelled strongly of borage, mixed with a smell of cucumbers, It did not redden litmus paper, nor render green paper tinged with the infusion of red roses; but it sensibly reddened the watery tincture of litmus, which had been so diluted with distilled water as to appear of a pure blue.

It immediately rendered lime water turbid. A few drops of very pure sulphuric acid, poured into it did not alter its transparency, nor excite any nitrous, muriatic, or acetous odour, although, after a few minutes, some very small bubbles were disengaged.

It immediately rendered white the solutions of oxalate of ammonia, muriate of barytes, nitrate of lead, and sulphate of silver. It also threw down a white precipitate from oxygenized muriate of quicksilver (i. e. corrosive sublimate); half an hour afterwards lime water was added in great quantity to the mixture, which augmented the volume of the precipitate, but did not turn it yellow; so that the oxygenized muriate of quicksilver had been converted into a muriate ad minimum.

On being mixed with the solution of the yellow sulphate of quicksilver in sulphuric acid, and purified potash being added, opaline flakes were at length thrown down; whereas, if plain water had been used, yellow flakes would have fell down immediately.

Hence it appears, that this distilled water contains carbonic acid, sulphate of lime, and a disoxygenizing principle. Other specimens of borage, some being less fresh, have yielded the same phenomena, but less distinct.

The disoxygenizing principle is also found in other distilled waters, as in that of potentilla anserina, and of lactuca virosa; the water of the last also contains a fetid volatile oil, which may be rendered visible by adding a little alkohol at 37°.

That the decomposition of the sulphate of silver was owing to sulphate of lime, was evident from the following experiment: sulphuric acid was added in excess to lime-water; into this a little acid sulphate of silver was dropped, which immediately threw down flakes, insoluble in muriatic acid. This great cohesive at-

traction of the oxide of silver, ought to hinder us from placing too much reliance upon the test of the precipitation of silver, as indicative of the presence of muriatic salts.

In Fourcroy's chemistry it is said, that the sulphate of quicksilver, with excess of oxide, is precipitated gray by alkalies, but this is probably an error of the press, as that chemist discovered this property to belong to the neutral sulphate of quicksilver.

Observations.—A paper by Mr. Descroizilles the elder upon distilled waters, may be seen in our Second Volume, *p.* 456.

On Filtering-Stones, and on the Method of ascertaining the specific Gravities of very porous Bodies. By Mr. GUYTON.—*Ann. de Chim.* No. 179.

LINNÆUS and Wallerius referred the stones which transmitted water to the genus *cos*, or of sand stones. Influenced by them, the latter mineralists have constantly considered them as varieties of arenaceous quartz. Kirwan alone places them among the siliceo-calcareous stones.

The filtering-stone used at Paris is yellowish grey, of a middling fine grain, capable of being cut with a toothed saw. It wears away under the finger, and produces a fine powder when two pieces are rubbed together. It absorbs 1-eighth of its weight of water. Its specific gravity is 2.322. It is soluble in nitric acid with effervescence, and thus appears to be composed of 87.89 of carbonate of lime, and 12.11 of silica. The place from whence it comes is concealed; but on consulting the descriptions which Brisson gave in his essay on the specific gravity of the stones used in building at Paris, it soon appeared that ten of these were similar in their grain, and the quantity of water that they absorbed, to the stone used for filtering.

The true sand-stones do not absorb even $\frac{4}{100}$ of water, and hence we may conclude, that the filtering-stone used at Paris is not a sand-stone, but a lime-stone, holding 12 or 13 per cent. of silica, and that many of the quarries about Paris furnish it.

The specific gravity of the stones, as quoted by Brisson, are less than the above; but this is owing to his method of determining them. He adds the weight of the water they absorb to the weight that is necessary to restore the equilibrium when they are weighed in water. A method which, although followed by many persons, appears erroneous. According to this method, the specific gravity of the filtering-stone, just examined, was only 1.813.

Sand-stones and filtering-stones are not the only stones that absorb water, chalcedony, pitchstone, steatite, asbestus, mesotype, schistus, as also some varieties of mica and of jade. Ludicke has described schisti, of which the hygrometrical phenomena were so

exact and constant that they might be compared with those of the hair hygrometer.

The true idea of specific gravity is the proportion between the weight of the body, and the volume occupied by those parts of it which are sufficiently contiguous to prevent the access of the surrounding fluid: many mineralists not attending to this, have quoted the specific gravity of pumice stone as inferior to that of water.

When pumice stone was examined in powder, its specific gravity turned out to be 2.142.

Experiments made by the Galvanic Society. By Mr. Riffault.—*Ann. de Chim.* No. 179.

As Brugnatelli had avoided in his apparatus (see our 2nd vol. page 247) the admission of any extraneous substance, the society determined to adopt his method.

Very pure distilled water was put into a tube which communicated by a syphon to a glass of the same water; a gold wire plunged in the water in the tube, and a slip of tinfoil plunged into that in the glass, connected the water with a pile of 100 square plates of zinc and copper. The plates were 80 millimetres square, and separated by cloth moistened with a solution of muriate of ammonia. At the expiration of 60 hours a fresh pile was applied in the room of the other

The water in the tube (which had been connected with the zinc end of the pile) smelt strongly of oxygenized muriatic acid, it did not taste acid, but it reddened litmus paper. Nitrate of silver instantly produced a cloud in it, and threw down a precipitate of muriate of silver. The water in the syphon, and in the glass was scarcely altered.

This experiment was repeated a great number of times, with piles of different strength, and the operation continued for a greater or less length of time, with nearly the same effects, sometimes the tincture of litmus was not altered. In one experiment the presence of oxygenized muriatic acid was very perceptible. In another, the water in the glass presented indications of being alkalized, for a portion of it being poured into tincture of litmus reddened by the water in the tube, restored the colour.

Facts relative to the Gallic Acid By Mr. Bouillon, Lagrange. *Ann. de Chim.* No. 179

The present paper is a continuation of the essay on tannin, of which an abstract was given in our second volume, p. 85.

The gallic acid has been examined with attention by many che-

mists, and particularly by Scheele. The following remarks by Bartholdi are important: all bodies that furnish oxygen to the gallic acid render it brown; and the acid itself, while carbonizing, forms by a slight combustion, colouring matter. Thus the red oxide and quicksilver boiled in gallic acid became black; the residuum was quicksilver mixed with carbonaceous powder: the supernatant liquor being saturated with the carbonates of potash, or of soda, did not throw down a blue precipitate from sulphate of iron. The same results took place when oxide of manganese was employed.

On the other hand, Bartholdi thinks that bodies which abstract oxygen from gallic acid, render it less coloured. A solution of gallic acid boiled upon charcoal became as clear and colourless as water, and remained so as long as it was kept from the contact of the air. It precipitated sulphate of iron black.

Scheele's process for gallic acid by infusion, and that of Deyeux by sublimation, are too well known to be here recited.

Bartholdi proposed to evaporate the tincture of galls to dryness, to dissolve the residuum in water, and add sulphuric acid till the liquor tasted very acid. The extractive matter fell down in a few hours, and the sulphuric acid was separated by barytes. The precise quantity of barytes is very difficult to be ascertained, and the liquor affords by evaporation an austere matter, not crystallisable, and retaining much tannin.

Richter macerates powdered nutgalls in two successive waters, unites the liquors, and evaporates to dryness: the residuum he treats with warm alkohol at twice; the mixed tinctures he distills to an eighth, which then crystallises on cooling. This he purifies by re-dissolution in water, and careful crystallisation. The crystals, he says, are prismatic, very white, and extremely light.

The acid, by Deyeux's process is perfectly white; the others contain tannin. Mr. L. could never procure the acid by Richter's process otherwise than straw colour, and in every attempt to purify it, some of the acid was constantly decomposed, and the alkohol became brown.

Berthollet proposed to purify the gallic acid of Scheele by treating it with oxide of tin precipitated by an alkali from muriate of tin; but when the liquor was evaporated to the consistence of honey, and then treated with water, the solution was clear, limpid, tasteless, inodorous, and left no residuum when evaporated. In another experiment, 61 gr. of gallic acid were dissolved in water, and treated with an equal weight of oxide of tin; by this means the crystals were rendered whiter, and still precipitated glue, although slightly. But on treating the same acid with 30 gr. more of oxide of tin, it became colourless, did not precipitate either sulphate of iron or glue, nor could any crystallised acid be obtained by evaporation: so that the gallic acid is in fact decomposed.

To examine Bartholdi's processes, gallic acid was boiled upon

red oxide of quicksilver; at first the liquor became dark brown, in which case it was still acid; but on boiling it on more oxide, it became colourless, and contained neither tannin, nor gallic acid. The oxide became black, a portion of it was reduced, the remainder was mixed with concrete phosphoric acid: when calcined charcoal was used instead of the oxide, the gallic acid lost its taste and became green; it did not precipitate glue, and yielded only a violet blue tinge with sulphate of iron; treated again with charcoal it was entirely decomposed; and left on evaporation a brown substance, which precipitated acetate of lead, of a dirty gray, and the nitrate of quicksilver and muriate of tin, of a yellow colour, thus resembling extractive matter.

Sublimation then appears to be the only method of purifying gallic acid; and even this produces an alteration in it, as appears by the following comparative experiments.

Scheele's crystallised acid yields a light citron coloured solution in water, which darkens by the contact of the air; it reddens tincture of litmus; with lime water it produces a blue colour, which by a further addition changes to peach-blossom colour, and if a few drops of nitric acid be added, it becomes rose-colour. The same appearances take place with barytes. Carbonate of soda produces a greenish colour; but carbonate of ammonia does not alter the colour of the acid. Pure potash becomes of a deep brown, and ammonia reddish brown. Green sulphate of iron becomes of a violet blue, and is not changed by any additional quantity. Nitrate of quicksilver yields a yellow precipitate; acetate of lead, a white, as also muriate of tin. The oxygenized muriatic acid did not have any visible effect upon this acid. Glue is copiously precipitated by it.

Richter's acid possesses the same qualities, except that it only slightly precipitates glue.

Deyeux's sublimed acid, while dissolving in warm water, yields an aromatic smell, and a slight oily pellicle. The solution exposed to the air, becomes brown, and is decomposed; it slightly reddens tincture of litmus. Lime water produces with it the colour of wine lees, which by excess become fawn colour. Barytes produces the latter colour, and the liquor is immediately covered with an oily pellicle. Carbonate of ammonia produces no alteration, but the carbonate of soda produces a fawn colour: pure potash renders it very brown; but ammonia produces a much clearer colour. The addition of a few drops of sulphate of iron produces in general a blue colour, which turns violet; frequently however, a deep green is produced; this probably arises from the greater oxygenizement of the iron, for muriate of iron ad maximum always yields a green colour. It precipitates nitrate of quicksilver, of a blackish colour, and acetate of lead, fawn colour and very slight. It has no effect on muriate of tin. Oxygenized muriatic acid renders it brown, but an excess discolours the acid. It does not precipitate glue.

The production of a green colour with sulphate of iron is much less decisive in the crystallised acids, and the cold infusion of galls always produces a permanent blue colour.

That these acids are very different is evident; but it is not easy to say whence their difference arises. Berthollet has indeed shewn that Scheele's acid contains tannin; the sublimed acid appears to contain an oil; indeed, if it is dissolved in ether, or in alkohol, and rubbed on the skin it produces an effect similar to that produced by a resin dissolved in alkohol.

Deyeux having already examined with great care the action of caloric upon nutgalls, it is only necessary to say a few words respecting the acid liquor thus obtained. It is aromatic, slightly milky, and very acid; it does not precipitate glue, it yields with sulphate of iron a violet blue colour, which turns to a dirty green. Lime, as also barytes, gave it a peach-blossom colour. It yielded a blackish precipitate with nitrate of quicksilver, and white ones with acetate of lead, and muriate of tin. On being saturated with potash, and evaporated, a brown residuum was obtained, which on sulphuric acid being added, exhaled the odour of acetic acid

Cold water was agitated for a few minutes alone with powdered nutgalls: the filtered liquor was golden yellow. Part of this being distilled, yielded a limpid liquor slightly acid, which did not precipitate sulphate of iron or glue. Another portion after being saturated with carbonate of soda, was evaporated to dryness, and then re-dissolved in water. To this solution sulphuric acid was added in excess, and the mixture distilled. An insipid inodorous liquor first came over, then an acid, but this was not either the sulphuric nor gallic. The same results were obtained from an infusion of galls treated in the same manner.

Nutgalls were distilled along with water, in a common still. The first running was not acid, but the last portions were, but they did not precipitate glue; the latter portions saturated with potash, and added to nitrate of quicksilver ad minimum, yielded a precipitate which had all the external appearances of nitrate of quicksilver. So that there can be little doubt but that nutgalls contain acetic acid, which combines with a small quantity of volatile oil, and perhaps a little tannin.

The oil may be rendered sensible by adding a little water to the solution of the sublimed gallic acid in very pure sulphuric ether, for it then rises to the surface, but soon disappears again. Concentrated solution of pure potash being added to the tincture, instead of water, separates a milky substance, which requires a deal of water to dissolve it and the liquor remains constantly turbid. This ethereal tincture produces a fine blue colour with sulphate of iron. By exposure to air it deposits the acid in a brilliant varnish-like mass, separating into scales.

The ethereal tincture of nutgalls themselves produces similar appearances, but it contains more tannin.

To increase the proofs that acetic acid combined with other sub-

stances, constitutes the gallic acid, several of the gallates were examined.

The gallates of lime, of barytes, of potash, and of soda, gave a violet red colour with sulphate of iron, and scarcely precipitated glue. After sulphuric acid had been added, they were distilled, and acetous acid was obtained from each of them. The residuum contained the sulphate, and its mother water slightly embrowned sulphate of iron, but this might be owing to the blackness of the mother water.

The gallates boiled with charcoal, first lost their property of precipitating glue and then that of precipitating sulphate of iron. The remaining liquor, evaporated to dryness, and distilled with sulphuric acid, yielded the acetic.

Deyeux said that when gallic acid was decomposed by heat, it yielded oxygen and carbone; but Berthollet obtained only carbonic acid gas without any oxygen: here no mention is made of hydrogen, which is very strange, gallic acid was therefore distilled, and the aeriform products collected. The first jars contained only atmospheric air, and the latter appeared to contain only carbonic acid gas. But on absorbing the acid with potash, a residuum of gas was obtained which burnt with flame, and was evidently carburetted hydrogen. That so small a quantity of hydrogen is obtained arises probably from the formation of water.

From hence, it appears that the gallic is an acid of secondary composition; indeed much more acid is obtained by Scheele's process than by sublimation. It is probable that the acetic acid combines with some of the tannin and extractive matter, to form Scheele's acid; and that the tannin is decomposed and a volatile oil formed and combined with the acid produced by sublimation, which has some analogy with benzoic acid, and perhaps ought not to be regarded as a modification of gallic acid. The acetic acid seems to be the only vegetable acid, which combining with other immediate principles of vegetables forms various species of acids, that can only be decomposed by reducing them to their remote principles, viz. oxygen, hydrogen, carbone, and azote.

Observations.—We have already in the last volume, p. 508, expressed our sentiments respecting the numerous acids, (and some other immediate principles of organized bodies) being considered as modifications of only a few species. This mode of expression, under the mask of simplicity, produces nothing but the greater confusion of our ideas upon the subject. Mr. Lagrange, at the same time that he is evidently for separating the two acids, hitherto confounded under the common name of gallic acid, and of restricting that appellation to the acid procured by infusion in the manner of Scheele, does, in our opinion, plunge into still greater difficulties by supposing all, or nearly all the acids from organic bodies to be combinations of the acetic acid with

other immediate principles. Carbone, hydrogen, and oxygen combine indeed in a variety of proportions, but each of these compounds is a substance of the same *secondary* order, (if we may so express ourselves) of beings; and although from the great facility with which they combine with more oxygen they usually form acetic acid as the last stage before the final formation of carbonic acid, we cannot fairly conclude them to be mere combinations of that acid.

Facts towards the Chemical History of Prussiates. By Mr. Proust.—*Ann. de Chim.* No. 179, 180.

Prussian blue frequently contains silica, carbonate and sulphate of lime, sulphate of potash, phosphate of iron, red oxide of iron, sulphur, ammonia impregnated with oil, and other matters. It is therefore proper to use that prepared without alum, and well washed with acids and boiling water. The purest Prussian blue does not contain prussiate of potash, as stated by Berthollet, for it does not leave any saline matter on distillation. It has a coppery tinge like indigo; it loses 45 per cent. by combustion, and leaves only red oxide of iron.

Caustic potash boiled upon Prussian blue, leaves a residuum of red oxide of iron, and alumine. Acids applied to the residuum, do not extract any colour from it, if it has been finely pulverized and diligently washed. In the ordinary process it frequently happens that the residuum contains some blue that has not been despoiled of its acid, or a mixture of prussiate of potash, and of a ferruginous alkaline carbonate, or all together. If the residuums effervesce with acids, it contains the carbonates of potash, or of lime, the first of which may be separated by careful washing, and the second by vinegar; for red oxide of iron does not combine with the carbonic acid, but only the oxide ad minimum.

A lb. of very good Prussian blue will yield $9\frac{1}{2}$ oz of crytallised prussiate of potash, which sometimes forms crystals of an inch in diameter. If sulphuric acid is present, it requires at least four crystallisations to separate the sulphate of potash from the prussiate. The mother water contains alumine, sulphate and phosphate of potash, ferruginous alkaline carbonate, &c; and therefore the pure salt ought to be used in analytical processes instead of the alkaline ley of Prussian blue as is most usual. The pure prussiate is not decomposed by boiling, it is not soluble in alkohol; and if alkohol is poured into its aqueous solution, it is precipitated in snow white flakes, which preserve their lustre in drying, so that they might be mistaken by their silvery gawsiness, for acetate of quicksilver.

This triple prussiate has a sweetish yet slightly salt taste, with a slight after-taste of bitterness. It is of a fine citron colour, which

arises from the black oxide of iron that it contains, and renders it crystallisable, and able to strike a blue colour with solutions of iron containing the oxide ad maximum. This iron however seems to be combined with the acid itself, rather than with the alkaline prussiate, notwithstanding it is not separable by alkaline hydrosulphurets, which has no effect on this salt, although it decomposes any ferruginous carbonate that may accidentally be mixed with it.

The hydrosulphurets do, however, contribute to the obtaining of white prussiate in purity. A diluted solution of green sulphate of iron (which had been kept upon sulphuret of iron, in order to prevent the too great oxygenizement of the metal) poured into a matrass containing prussiate of potash, dissolved in boiling hydrosulphuretted water, produces a white precipitate: but as soon as the matrass is taken from the fire, the atmosphere acts on the milky fluid, it becomes cloudy, and turns at length to a fine blue.

Crystallised prussiate of potash dropped into a boiling dilute solution of green sulphate of iron, produces a similar precipitation.

A crystal of prussiate of potash dropped into nitrate of iron becomes instantly of a deep blue, so as to resemble black velvet; but dropped into green sulphate of iron it splits, and falls to a white powder.

Nitrate of iron dropped into a boiling solution of prussiate of potash, throws down a fine blue: but if hydrosulphuretted potash, or ammonia is previously added to the prussiate, the precipitate is at first blue, and changes rapidly to white.

If the solution of green sulphate of iron is mixed with 3 or 4 times as much muriatic or sulphuric acid, it does not hinder the production of white prussiate. More concentrated acid alters the colour, but never brings it to a complete blue, not even if the muriatic acid is boiled upon the prussiate. Prussic acid is indeed disengaged, and the acid takes up some of the black oxide, then the blue prussiate formed by the access of the air, falls down, and changes the white to green.

Muriatic acid boiled upon blue prussiate, produces prussic acid, and leaves the red oxide; but its action is slighter than in the white prussiate.

The triple prussiate boiled with weak muriatic, or sulphuric acid leaves 35 per cent of blue. As Prussian blue, when decomposed by ignition, or by nitric acid leaves 35 per cent. of red oxide, the above residuum would contain 17 of black oxide, or 19 of red oxide, which unites with the iron really contained in the substances analyzed by this re-agent, and thus produces confusion.

When common potash is boiled upon Prussian blue, some of the alkaline carbonate takes up part of the red oxide. It is this ferruginous carbonate that is contained in the Prussian leys, and occasions a blue precipitate in the addition of acids. When therefore Prussian leys are used in analysis, they introduce first the red oxide

which forms part of this alkaline carbonate, as well as the black oxide belonging to the triple prussiate. So that the prussiates can only be considered in the same light as litmus, nutgalls, &c. as proper to indicate the presence of such or such principle.

Sulphuric acid may also be used to decompose the triple prussiate, which then yields 115, or 116 per cent. of sulphate of potash.

Prussiate of potash loses 10 per cent. of water by distillation.

Boiling vinegar also decomposes the prussiate of potash, a white prussiate is formed which does not change to blue so speedily as when other acids are used.

When Prussian blue is made, the oxide of the sulphate employed is reduced by the exposure to the air, to the maximum of oxygenizement viz. 48 per cent. but the black oxide combined with the prussiate of potash still retains its state. Boiling nitric, or muriatic acid by destroying Prussian blue can indeed reduce this oxide to redness but as long as it preserves the form of blue, it always retains its minimum of oxygen. The red oxide of iron does not form any combination with prussic acid, but the black oxide forms a green prussiate which is changed to blue by the air.

The hydrosulphuret of potash kept for some days upon Prussian blue in a close vessel, is changed into triple prussiate of potash, and the red oxide of the blue is converted into black hydrosulphuret. In like manner hydrosulphuretted water can only reduce Prussian blue to white prussiate: and all the metallic solutions which form prussiate with the triple prussiate of potash retain obstinately the black oxide. If pure potash is applied to Prussian blue which has been exposed to the air, or to the acids which part the most easily with their oxygen, it constantly takes up only the same charge of black oxide. Potash also applied to prussiate of manganese, becomes crystallisable yellow triple prussiate with black oxide. The blood red prussiate of copper is another triple salt of the same kind, for the simple prussiate of copper is yellow. Some other oxides form triple combinations of this kind, and their examination may occasion the discovery of colours as valuable as Prussian blue.

Prussian blue, by distillation yields carbonate of ammonia, a little carbonic acid gas, and much gaseous oxide of carbone; the water in the pneumatic trough contained prussiate of ammonia, which produces a blue colour with solutions containing an oxide of iron ad minimum, but not with oxide ad maximum. The residuum was very pyrophoric, and after being kept in an ill closed bottle so long as to lose that quality, it took fire on adding nitric acid at 40°. and burnt so vividly, as to render it probable that the iron was inflamed as well as the charcoal. The iron in this residuum seems combined with carbone into a kind of steel, as it yielded on solution, strongly scented hydrogen. It is surprising that no oil is formed in this distillation.

The triple prussiate by distillation, first loses 10 per cent of water and becomes white; at a red heat it softens, and when it melts prussiate of ammonia is formed. A sublimate arises during the fusion which has the taste of the simple prussiate, but which is only partly soluble in alkohol, the triple prussiate unaltered being separated. If a lighted taper is put into the neck of the distilling vessel, the prussic acid is burned; and the carbonic acid formed by its combustion unites with the ammonia, and forms carbonate of ammonia. The melted prussiate resembles melted muriate of soda, it is ash gray, and attracts moisture. It has an alkaline taste with some bitterness like kernels of fruits, acids separate carbonic acid gas, hence it appears to contain the simple prussiate along with some carbonate of potash.

This residuum treated with water deposits a mixture of charcoal, iron, and a little sulphuret of iron, which last arises from some sulphate of potash, that can scarcely be separated, from the prussiate. The solution is precipitated in brilliant snowy flakes by alkohol; these flakes re-dissolved and crystallized, yield sweetish yellowish crystals, which produce prussic acid and white prussiate by means of muriatic acid. The alkohol being distilled almost to dryness, fresh alkohol poured in the residuum took up the simple prussiate, and left carbonate of potash with some remains of the triple prussiate.

The simple prussiate may be obtained by saturating potash with prussic acid gas; or more speedily by digesting alkohol upon the concentrated ley of animal charcoals. These leys usually contain some hydrosulphuret, which unites with the alkohol at the same time. This hydrosulphuret generally originates from the sulphate of potash contained in the common potash, although it is found when even the purest potash is employed. As sulphur is also found in the ammoniacal products of blood, it appears that it may unite with the carbone in the same manner as phosphorus, but not combined with the iron, for the hydrogen although of a strong smell betrays not the least sulphur.

The simple prussiate is easily known by its taste, and its perfume which fills the mouth. It precipitates solution of copper yellow, and does not form a blue precipitate with a solution of red oxide of iron, but throws down a yellow ochrey precipitate, like the pure alkalies; but it forms blue with the common green sulphate, because it first forms a triple prussiate, and then acts upon the remainder of the iron. If the prussiate is black, it is owing to sulphuretted oxide formed from the alkaline hydrosulphuret, this may be separated by adding a few drops of an acid.

The simple prussiate cannot be kept in open vessels, because even carbonic acid decomposes it; nor will it crystallise, but only forms a mass containing a few crystalline plates. Scheele proposed it for a re-agent, but, as the iron is mostly reduced in analytical processes to a maximum of oxygenizement, it is seldom of any use.

By boiling the aqueous solution of the simple prussiate, its acid escapes at first unaltered, and may be inflamed, if the boiling is performed in narrow necked vessels. Afterwards the acid is decomposed and forms a carbonate of ammonia, which when the water is exhausted, may be collected in a solid form. After repeated abstractions of water from the salt, the saline residuum still contains some prussic acid. Alkohol poured upon this residuum takes up the undecomposed prussiate, and leaves carbonate of potash. The fresh simple prussiate does not precipitate muriate of lime, but that which has been long boiled, throws down carbonate of lime; and fresh prussiate throws down three times as much Prussian blue, as that which has been boiled.

The simple prussiate dried, and melted at a red heat, yields carbonate of ammonia, with an oily vapour resembling that of hartshorn, the residuum is carbonate of potash, mixed with charcoal, and some undecomposed prussiate.

The leys used for preparing Prussian blue contain both simple and triple prussiate, hence, as the former is decomposed by boiling, we can see the utility of Curadau's, addition of a little sulphate of iron previous to their concentration, as this changes the simple prussiate into triple, and this is not injured in the least by boiling.

Respecting the decomposition of the prussic acid, and its conversion into carbonate of ammonia, a difficulty arises to discover whence the oxygen of the carbonic acid is taken, whether from the prussic acid, or from decomposed water. This cannot at present be decided, although as Berthollet observes, it is difficult to conceive the existence of oxygen in a substance composed of elements which have so strong an elective attraction for it, especially as the prussiates can bear a high degree of heat without being decomposed.

The two prussiates of potash yield different precipitates when applied to metallic solutions, as has been observed by Scheele. Mr P. has examined the following.

Silver, by the triple prussiate is precipitated white, but it turns blue, on account of the white prussiate of iron that is mixed with it. The simple prussiate produces a white curd that does not change.

Gold, is not precipitated by the triple prussiate, but the simple throws down a white precipitate that changes to yellow. This precipitate is not fulminating; but yields, by heat, water, empyreumatic oil in abundance, carbonaceous gas burning with a blue flame, and leaves behind gold mixed with charcoal.

Molybdenic acid, and oxide of tungsten, are neither of them affected by either of the prussiates.

Titanium not being obtained at present without iron, shews the same phenomena as the red oxide of that metal.

Uranium is precipitated by triple prussiate of a blood red; by the simple of a yellow white.

Cobalt is precipitated by triple prussiate of an herbaceous green; by the simple of a light cinnamon.

Nickel is precipitated by triple prussiate of a greenish white; by the simple, of a yellowish white.

Manganese is precipitated by triple prussiate of a peach bloom colour; by the simple of a dirty yellow.

Copper is precipitated by triple prussiate of a fine crimson; by the simple of a yellow. Muriate of copper ad minimum, is precipitated by the triple prussiate of a white, but as the muriate can scarcely be preserved at the minimum, it is mixed with crimson, which renders it rose colour: by the simple prussiate, it forms a very white curd, which by the addition of a few drops of pure potash is decomposed, yellow oxide of copper ad minimum being separated.

Platina is not precipitated by either of the prussiates.

Prussiate of quicksilver is obtained by heating the red oxide of quicksilver with Prussian blue. It is always opake, and forms tetraedral prisms. It may retain potash if it was contained in the blue. It contains iron, for it lets fall white prussiate on being heated with muriatic acid; this iron may be separated by repeated boilings upon red oxide of quicksilver, oxide of iron is deposited, and the prussiate then crystallises with difficulty in groups of fine needle-like crystals; the addition of fresh prussiate does not cause the crystals to assume their former prismatic shape.

Prussiate of quicksilver is totally decomposed by heat, and is inflammable, the prussic acid, and gaseous oxide of carbone burning with a red and blue flame, terminated by a yellowish aureola. By distillation it yields 72 per cent. of quicksilver, also ammonia, oil in some quantity, carbonic acid gas, and gaseous oxide of carbone, leaving eight of a mixture of charcoal, and carbonate of potash, the last being owing to some impurity.

The oxide of quicksilver ad minimum does not seem to combine with the prussic acid, as that acid, applied to muriate or nitrate ad minimum, throws out some of the quicksilver, so as to reduce the oxide ad maximum, and then combines with it.

Red oxide of quicksilver decomposes the simple prussiate of potash, and the metallic salt crystallises in the alkaline ley. It also decomposes the triple prussiate, but this requires a long boiling; the black oxide of iron takes some of the oxygen from the oxide of quicksilver, and thus forms a yellow oxide, this is deposited along with some of the quicksilver, viz. that which furnished it with oxygen.

Prussiate of quicksilver is not decomposed by dilute sulphuric acid, even when heated; potash separates the sulphuric acid, but has no other effect. The concentrated sulphuric acid acts by destroying the prussic acid. It is not decomposed by nitric acid, but crystallises as usual; a little nitrous gas, however, is disengaged, that comes from the black oxide which the prismatic prussiate contains. Muriatic acid disengages prussic

gas from it, and changes it into corrosive muriate of quicksilver. It is not soluble in alkohol, and when dissolved in potash, it may be separated by that liquid. The prussic acid is separated from it by muriate of tin ad minimum, and hydrosulphuretted water. It is not altered by muriate of ammonia, and the mixed solution is not precipitated by potash, lime water, or even green sulphate of iron.

The prussic gas disengaged from the triple prussiate, by heating it with weak sulphuric acid was rapidly absorbed by alkohol, and by water. The water thus charged has a penetrating and suffocatory odour; it tastes of kernels. It can with difficulty be contained in the vessel, throwing up the stopple and escaping; but if retained by force, it turns yellow in four or five months, ammonia is formed, and a brown carbonaceous sediment is deposited. This sediment yields by distillation a little water, prussic acid and ammonia. An azotized charcoal is left, for when heated with carbonate of potash, it yields Prussian ley. While fresh it does not render green sulphate of iron turbid; but when spontaneously altered, it throws down a blue colour. The liquor itself, when altered yields prussiate of ammonia by distillation, but Mr. P. has forgot whether it was accompanied or not with carbonic acid.

Alkohol charged with prussic gas is a permanent combination, and indeed the prussic acid more nearly approaches the nature of oily and combustible bodies, than that of saline substances.

The best Prussian ley is formed from equal parts of charcoal of blood, and carbonate of potash heated in a covered vessel. The mixture of lime does not render it any better, 144 gr. of charcoal were diminished to 40 gr. by treatment with the carbonate, and on repeating the process with the remainder, and as much carbonate as before, it was again diminished 42 gr. The Prussian blue from the first ley was twice the volume of that from the second. Ley formed from a mixture which had been heated red only half-an-hour gave very little blue; those from mixtures heated an hour and quarter, gave a considerable quantity, and were nearly equal among themselves.

Charcoal of blood moistens in the air; by elixiviation it yields common salt, and carbonate of soda holding a little prussic acid. It yields by treatment with carbonate of potash less blue the second time than the first, still less the third, and none the fourth. The thus exhausted charcoal burns with ease, and without its former ammoniacal smell; but it does not become inflammable by nitric acid like vegetable charcoal. As azote is capable of forming combinations resisting intense heats, Mr. P. asks if it has any influence in the formation of steel, which is usually made with animal substances.

Washed charcoal of blood distilled with an equal quantity of pure potash yielded simple prussiate of ammonia, and much gas, smelling of the prussic, and burning with a red flame. When distill-

ed with oxide of manganese, the same charcoal yielded carbonate and prussiate of ammonia. Distilled with clay and common salt, but little sal ammoniac was produced.

The azotised vegetable charcoals will produce Prussian blue, as those of gluten of wheat, of chich peas, of indigo, and of stone coals; they sometimes also yield hydrosulphuret. The charcoal of sugar and sugar of milk do not form blue, nor that of chesnut wood or of heath: so that the two latter charcoals do not owe that difficulty of combustion, which causes them to be preferred by smiths, to azote.

The coal of cream of tartar does not form Prussian blue, nor of cream of tartar with nitrate of soda, nor of a mixture of two parts of the cream, and one of sal ammoniac; but that from four of the cream with one of the salt, yields a ley that contains the simple prussiate. As azote therefore, appears to be the sole cause of the superiority of animal coals, if there should hereafter be discovered any azotic combination that will bear a greater heat than the ammoniacal salts, it is possible that prussic acid might be much easier made than by using animal coals.

Prussian leys always contain prussic acid and ammonia; as also a quantity of carbonate of potash, simple and triple prussiate of potash, sulphate of potash, phosphate of lime, and sulphur. They deposit the phosphate of lime during evaporation. If the ley is precipitated by green sulphate of iron and the precipitate washed, the washings contain phosphate of iron. Alkohol separates the simple prussiate from the triple which remains along with the carbonate of potash; but some of the simple prussiate seems to be always left behind.

The quantity of blue precipitated from Prussian ley, by the common green sulphate was four times as much as that precipitated by the red sulphate. The ley contained disengaged prussic acid, and on saturating this with potash, the ley yielded not an atom of blue with the red sulphate, although its effects on the green were as usual. Mr. P. had formerly recommended the red sulphate because the blue was darker, but the other blue is soon rendered dark by the air.

The solution commonly used to be precipitated by the Prussian ley, is composed of 4 parts of alum, and 1 of green vitriol, which yields plenty of blue; but on previously oxygenizing the solution by means of oxygenized muriatic acid, it yielded only a pale precipitate, containing a little blue scattered through the alumine.

The leys made by boiling alkali upon Prussian blue always yield blue, because they contain only the triple salt; but those of coals require the addition of the black oxide of iron. It does not seem owing to any want of iron in the charcoal of blood, that prevents the formation of the triple prussiate, for the ashes yielded by charcoal which has been used for these leys still contain a quantity of iron, but rather that one part of it becomes simple prussiate by losing its oxide, as when it is heated by itself.

It is surprising that the iron contained in the triple prussiate is not reduced by its contact with the charcoal. This part of the process is very obscure, we neither know when the prussic acid is formed, nor if it is destroyed and then re-produced, nor the proper degree of heat in order to procure the greatest quantity of either of the prussiates.

Dilute sulphuric acid added to Prussian leys, disengages first carbonic acid, and afterwards prussic acid; after this it must be heated, it then acts upon the triple prussiate and white prussiate appears. Concentrated leys frequently deposit crystals of triple prussiate. The goodness of the ley may be known by its taste resembling kernels, which is very distinct from that of the potash. If it does not fill the mouth well, the mixture has not been sufficiently heated, or the charcoal has been employed too sparingly. It seems most advantageous to heat the mixture in covered crucibles, as no stirring is necessary.

Some green sulphate of iron ought always to be added before the ley is concentrated by boiling, in order to change the simple prussiate into the triple. The sulphate first reddens the ley, it then becomes yellow, an excess of sulphate has no further effect, because the contrary excess of potash reduces it to an oxide, which falls down. The ley thus prepared does not yield any ammonia by distillation.

From the preceding facts, we may deduce the following propositions.

Prussic acid is composed of carbone, azote, and hydrogen in unknown proportions, although from the quantities of charcoal that it yields, the carbone seems to predominate. There is no indication of oxygen, nor could it be expected considering the attraction of the other elements for it, and the processes by which the acid is formed.

It has only slight acid properties, for its taste is different, it does not redden litmus, it is less soluble in water, although that is the proper solvent of acids, than in alkohol. It is subject to a spontaneous decomposition. It forms with the alkalies very imperfect combinations which retain most of the peculiar properties of the component parts, and are decomposed even by carbonic acid. Its combustibility, its taste, its aromatic odour, its production in volatile oils and kernels, its permanency when dissolved in alkohol, all render it more like to oily and inflammable bodies than to saline.

This acid however combines with great force to the oxide ad maximum of quicksilver, and acts in this instance as though it were a very powerful acid, and forms a very perfect metallic salt. It refuses to combine with the oxide ad minimum of quicksilver, but reduces one part of the oxide by withdrawing the oxygen from it and transferring it to the other part, so as to form the prussiate of quicksilver.

Prussic acid has no attraction for the red oxide of iron, but it combines with the black oxide, and would form with it white prussiate, but as the precipitate by the green sulphate of iron can

scarcely ever be obtained at the zero of suroxygenizement, it is always greenish. This precipitate changes to a perfect blue by drying, and therefore we may justly suppose that the prussic acid added to the base of the green sulphate would in other circumstances produce a prussiate as white as it can be obtained by more easy methods.

Prussian blue is not a simple combination, its basis is the red oxide of iron; but this oxide is not immediately combinable with the acid, nor does the solution of this oxide form blue with the simple prussiates. By applying potash to Prussian blue a yellow crystallisable salt is obtained, that contains black oxide of iron, which is an element necessary to the formation of crystallisable prussiate, of Prussian blue, and of all the metallic prussiates that are prepared with the triple prussiate of potash.

Some metals as copper, silver, manganese, cobalt, nickel, uranium, &c. form both simple and triple prussiates; others as gold, quicksilver, &c. form only simple prussiates; others again as iron, yield only triple; and lastly some form neither. All of these combinations except Prussian blue and prussiate of quicksilver are very little known. The black oxide of iron united with prussic acid, passes from one combination to another without alteration. And the basis of the salt may even be altered from the minimum to the maximum of oxygenizement without the black oxide of iron being affected in the least. It is not separable by the alkaline hydrosulphurets, nor can they affect the oxide in the triple prussiate of potash, or in Prussian blue.

This combination of prussic acid with black oxide, which is an essential constituent in the triple prussiate, is not known in a separate state.

The triple prussiate of potash cannot sustain a red heat without losing its black oxide of iron, and being reduced to the state of simple prussiate. On the other hand the simple prussiate is decomposed by a much lower temperature, the acid being destroyed, and changed into ammonia and carbonic acid. It is owing to the destruction of this prussiate that the Prussian leys are weakened by long boiling. Black oxide of iron, or a salt with basis of black oxide immediately changes the simple into the triple prussiate, and thus enables it to sustain a boiling heat without alteration.

It is this prussiate that was the test so much sought for by the chemists. t does not form Prussian blue with solutions of red oxide of iron unless they contain also black oxide, which may operate as a connecting medium between the acid and the red oxide.

Triple prussiate of iron, i. e. Prussian blue, being strongly heated, is reduced to ammonia, carbonic acid gas, gaseous oxide of carbone iron approaching to steel, and charcoal. Prussiate of quicksilver yields the same products, along with some oil.

Leys made from charcoal contain but little triple prussiate of potash, but a considerable quantity of the simple prussiate, They ought not to be concentrated until the latter has been rendered more permanent by being changed into the triple prussiate.

To obtain all the Prussian blue that these leys are capable of producing, a sulphate containing some black oxide of iron must be used, for the simple prussiate they may retain does not form blue with a sulphate containing only red oxide.

Observations.—This is, upon the whole, a very important paper, not so much from the new facts that it discloses, as from the manner in which the very intricate subject of the prussic acid, as it is called, is treated. Mr. P. acknowledges that Scheele made us acquainted with every thing here mentioned.

On the existence of Platina in the Silver Ore of Guadalcanal in Estremadura. By Mr. VAUQUELIN.—*Ann. de Chim.* No. 180.

HITHERTO platina has only been found in the gold mines of Santa Fe, in Peru; the reports of its discovery in Siberia, and in a ferruginous sand of Saint Domingo, not having been confirmed.

Having been ordered to analyse the famous ores of Guadalcanal, the mines of which place have lately been re-opened, but on a different spot, a large proportion of platina was found in one of the varieties of the ore.

This variety was gray, and resembled the fahlerz, or gray copper ore. It contained copper, lead, antimony, iron, sulphur, silver, and sometimes arsenic. The matrix is usually carbonate of lime; sometimes sulphate of barytes, and quartz are also found with it. The platina is in various proportions, as it is sometimes scarcely perceptible, and at others is in the ratio of 10 per cent., so that it does not appear to be a truly essential constituent part of the ore, any more than the silver which is equally various in its proportions, which varies from 2 to 7 per cent.

The process used to separate the platina was pulverization, roasting, fusion with potash, cupellation of the regulus, parting by aqua fortis, and subsequent washing and ignition of the separated powder. The addition of lead to facilitate the cupellation, and of silver to quart the mass previous to parting is occasionally necessary. If the aqua fortis was too strong, it took up some of the platina, and acquired a brown colour.

The platina appears to exist in this ore in its metallic form, for it is not soluble in the simple acids, but remains along with the sulphur and silica in the residuum; it was by examining the residuum that it was discovered.

None of the new metals found along with the South American platina are here present, so that the platina may be obtained in a state of purity at a moderate expense, or even none, as the silver must be parted to separate it.

Observations.—It has been supposed by the translator of this article for the Philosophical Journal, in which work it has been introduced, that the antient candlesticks in the cathedral of Hildesheim in Lower Saxony, which are mentioned by Prof. Cramer, in his letters on natural philosophy, as being white, and of a specific gravity nearly equal to that of gold, were made of the regulus obtained by the fusion of an ore similar to the present. This is not absolutely improbable, but that it was owing to the ignorance of Bishop Bernward, the maker of the candlesticks, who is acknowledged to have been a skilful metallurgist, is improbable; and seems only the ipse dixit of a chemist of the French school, purposely degrading the knowledge of other times and countries, to advance the opinion of his own. Granting that the candlesticks are an alloy of platina and silver, they are more likely to be an intentional alloy in a determinate proportion best adapted for the subsequent mechanical operations they were to receive, than a regulus obtained in the fusion of an ore. Since the great specific gravity of the mass must have attracted the bishop's attention, and we need go no further than the above paper of Mr. Vauquelin, to shew, that the platina could be obtained pure by the ordinary process for parting gold from silver; a process that must have been known by Bishop Bernward in his capacity of a goldsmith, to say nothing of any scientific metallurgical knowlege he might possess.

Should a further examination of these candlesticks shew them to be composed of an alloy of platina with silver, it seems probable that some of the silver mines in Saxony may contain this precious metal, and we recommend an examination of all the specimens of gray copper ore that can be obtained, for the purpose of discovering platina.

On dyeing Violet Purple, and its different shades. *By* Mr. J. M. Haussman.—*Ann. de Chim.* No. 180.

Water is not the only solvent that is necessary for extracting the colouring matter of plants in order to use it in dyeing; for some vegetable substances such as alkanet, will only give up their colouring matter to alkohol. The colouring matter of alkanet is so tender, that it is decomposed by the action of a heat inferior to that of boiling water. Even when extracted by means of alkohol, it cannot be concentrated by evaporation without injury; for when a fourth of the alkohol had been drawn off, the residuum was unfit for dyeing.

The tincture of alkanet mixed with 6 or 8 times as much water in a copper boiler, gave a fine violet purple to cotton prepared for Turkey red, according to the process published by Chaptal, in the Annales de Chimie. An. X. The fire being gradually

augmented to a boiling heat. It is necessary that the cotton should be very bright, and for that reason it must not be galled. The linseed oil employed was also very carefully boiled with white lead to avoid its being burned, that it might not dirty the cotton.

The violet purple thus produced on cotton, surpassing that dyed in the ordinary manner on sattins, led to the employment of it, for the ground of printed shawls of high price. The shawls thus dyed were extremely beautiful, but too high priced, for the present state of the Parisian market. The cotton goods intended to receive this ground ought to be previously well bleached, that it may be sullied as little as possible by the process, for although the violet purple is so solid that it is able to sustain without much alteration the action of alkaline ley and of oxygenized muriate of potash, still the white only slowly recovers its pristine beauty.

The alumine fixed upon the goods, and saturated with the colouring matter of alkanet, will still admit the colouring matter of other subsances, so as to produce a great variety of shades, this may be performed by weakening more or less the acetate of alumine, and adding madder, cochineal, kermes, brazilwood, woad, quercitron, &c. the shades may also be still more varied by the addition of acetate of iron.

Oxide of iron printed on the goods, or used in a concentrated solution of acetate of iron, is dyed of a greenish black by the tincture of alkanet. By weakening therefore, this solution a great variety of shades of gray may be obtained; all of which may be altered by the addition of the above drugs.

If it be wished to produce other colours by the side of the violet purple, the goods ought to be previously passed through dilute sulphuric acid, in order to get rid of the alumine that has not combined with the colouring matter of alkanet. This operation reddens the purple a little, but without much weakening of it.

Linen prepared like the cotton goods already spoken of, and silk which has been treated with allum, take the same colours with tincture of alkanet. This tincture, however, only fouls silk that has been soaked in any solution of tin, which shews the little attraction that oxide of tin has for the colouring matter of alkanet. Nor are the colours produced on cotton or linen treated with a solution of tin much better. It has not been tried with woollen.

Analysis of a Calculus, from the Human Bladder. By Prof. Vurzer.—*Ann. de Chim.* No. 180.

This calculus was nearly oval, but slightly compressed. It was brown externally, and yellowish white internally. It weighed 870 grains German weight. Its specific gravity was 1.572. Its surface was irregular, and rather unequal. It had the consistence of hard chalk, and was composed of layers but had no nucleus.

It was not in any degree soluble in water. It was partly soluble in cold muriatic acid, spec. grav. 1.181, the solution by the addition of lime water, threw down phosphate of lime. The undissolved residuum treated with a ley of potash was partly dissolved, the solution being decomposed by acetous acid, let fall a precipitate consisting of uric acid, and a small quantity of animal matter. The residuum not dissolved by the potash, on being burned, yielded a very strong odour of burned horn or hair, and left some silica behind.

From this mode of analysis the calculus was found to contain 17.35 per cent of phosphate of lime, 75.33 of uric acid, 6.32 of animal matter, and 1. of silica. The latter is very seldom found in calculi, having only occurred twice to Fourcroy and Vauquelin.

On the Acetates of Potash, and of Lead. By Mr. Proust—*Ann. de Chim.* No. 181.

Neither ammonia, nor prussic acid are yielded by the decomposition of the acetate of potash, so that Mr. Tromsdorf is perfectly right. The error arose from employing an acetate not prepared at home, and which from its appearance was judged to be pure, and to have been prepared with distilled vinegar, but that was not the case.

The production of ammonia from acetate of lead, is still doubtful.

On the formation of Muriatic Acid. By Prof. Pfaff.—*Ann. de Chim.* No. 180.

A great variety of experiments were made in consequence of Mr. Pacchiani's pretended discovery of the composition of muriatic acid; but where proper precautions were taken, no muriatic acid could be observed. On the other hand it was found (five years ago), that the water exposed to the positive end of the pile exhibited traces of nitric acid; which originated from the combination of the oxygen disengaged from the decomposed water with the azote, previously contained in the water: for when the water was carefully boiled for a long time, and the further access of it guarded against, these traces of nitric acid were diminished.

Some of the German chemists have stated that the muriatic acid arises from some animal matter employed to connect the apparatus; but if this animal matter is exhausted of the muriates of soda and ammonia that it always contains, by repeated boiling in water, no muriatic acid is formed.

The water exposed to the negative end of the pile, always

contains a little ammonia, originating from the combination of the hydrogen, disengaged from the decomposed water, with the azote contained in the water.

Experiments on the decomposition of Water, and production of Muriatic Acid, by the Electric pile. By Mr. PETER ALEMANI.—*Ann. de Chim.* No. 180.

IT is rendered certain by numerous experiments that the liquid which is used in the pile, has no effect either on the decomposition of water, or the production of muriatic acid; and therefore saline solutions are best for that purpose, because they so greatly encrease the force of the pile.

Two small tubes were placed side by side, and closed at bottom by a piece of well washed linen, each of these tubes had a smaller bent tube, and also a gold wire cemented by sealing wax into its upper extremity. The tubes were filled with distilled water of which they held seven scruples each, and were then plunged in a glass of the same water; the bent tubes were each of them adjusted to a separate small pneumatic apparatus. The gold wires were then connected with a pile of 900 disks of copper, zinc, and paper moistened with muriate of soda. The atmosphere being at first in a humid state, the pile did not act well, but when it became dry, the power of the pile was increased. The third day, the water connected with the positive end of the pile was rendered slightly yellow, and the volume of $3\frac{1}{2}$ scruples (of water) of gas was collected; in a little time after this, a red powder inclining to violet was suddenly thrown down.

The next day the gas collected on the positive side was in the whole equal in volume to $6\frac{1}{2}$ scruples of water, and was pure oxygen; the tube remained half full of water. This water reddened paper tinged by litmus, and the blue colour was restored by means of an alkali. Nitrate of silver threw down from it, a precipitate insoluble in nitric acid. The linen that closed the bottom of the tube was dyed violet red, nitro muriatic acid, and oxygenized muriatic acid instantly re-bleached the cloth, and it was re-dyed of a violet colour by nitro muriate of tin. The gold wire was corroded in every part, and reduced to a very small size.

The gas disengaged from the negative tube was pure hydrogen, and measured equal to $16\frac{1}{4}$ scruples of water. The water on this side was also diminished to one half. If reddened tincture of turmeric, and acids restored the original yellow colour, nitrate of silver threw down from it an ash gray precipitate, totally soluble in nitric acid.

To avoid any suspicions, the experiment was repeated with a pile, the paper disks of which were moistened with a solution of sulphate of alumine; and the same results were obtained.

From this it may be concluded that the radical of the muriatic acid has been discovered, and that the honour of the discovery is due to Mr. Pacchiani. It having been missed by Keir and Cavendish, who observed some traces of muriatic acid in the water formed by the combustion of hydrogen with oxygen.

On the Sulphurous Acid. By Mr. PLANCHE.—*Ann. de Chim.* No. 180.

BERTHOLLET has published two excellent papers on the properties of the sulphurous acid, to which Fourcroy and Vauquelin have made considerable additions; but none of these chemists have spoken of the changes which syrup of violets undergoes, when mixed with this acid.

The sulphurous acid made use of, was procured by decomposing sulphuric acid by means of quicksilver, the process of Berthollet being used; the syrup of violets was of a fine blue colour.

The syrup was diluted with 8 times its quantity of pure water, and then turned red by the nitric, muriatic, sulphuric, or phosphoric acids, or by radical vinegar. This reddened syrup being mixed with the sulphurous acid, immediately regained its former blue colour, but rather lighter.

The foregoing acids being added to the blue liquor, it became of a wine-red, but the acetic acid was slow in its operation, a large portion of it was required, and the resulting colour was only a light violet.

Sulphurous acid added to syrup turned red, by the oxalic, citric, tartarous, or acetous acids, also restores the original blue colour. But the subsequent addition of the several acids give rise to several different phenomena. A small quantity of oxalic acid does not produce any change, a larger portion produces a violet tinge, and the mixture requires several hours to recover some redness, which is only a pale rose at last. The tartarous, citric, or acetous acids, in any proportion do not re-produce the red colour, not even after twelve hours contact with the air, but the blue colour becomes lighter and lighter.

To examine the agency of the air, in producing these phenomena, the acids were added in stopt bottles, to the diluted syrup, whose colour had been previously reddened by the same acids, and then restored by sulphurous acid. The mixtures being shaken, and then left for 6 hours, none of them were found to be anywise changed red; but the blue was somewhat lighter.

The sulphurous acid gas, is rather weaker in its action than the liquid acid.

The same phenomena took place, when the sulphurous acid was procured by means of charcoal, or of sugar.

On the inflammable Gas formed during the Distillation of Peat. By Dr. Thomas Thomson.—*Philosophical Journal.* No. 68.

The nature of the inflammable gases, yielded by vegetables on being exposed to heat, has not yet been ascertained with precision. Some consider them as reducible to three kinds, which are already well known; others think that they are liable to infinite variations: both these opinions may be very justly controverted.

Three kinds of these gases have already been discovered, which are frequently produced in distilling vegetable substances:

1. *Carbonic oxide.* 2. *Carburetted hydrogen.* 3. *Super-carburetted hydrogen, or olefiant gas.*

The gas from peat appears to constitute a fourth kind, which may be called oxycarburetted hydrogen; a name applied by Berthollet to carbonic oxide, but which is more applicable to the gas from peat. Mr. Henry has examined some gas from peat, but the properties of the gas he obtained are different from those of the gases obtained from the peat used in Edinburgh.

This peat is soft, brown, very spongy, and loose. Its specific gravity is 0.600. It loses 1-4th of its weight by a heat of 300°. Fahr. At 400° or 500° it smoked, and was charred. Heated to redness in close vessels it leaves 25 per cent. of very brittle charcoal. When burned in the open air, it leaves a quantity of yellowish gray ashes, containing iron, equal to 1 per cent. of the peat. Good peat is much denser, and approaches more closely to coal.

In procuring this gas by distillation it was sometimes the same, though the heat differed; and sometimes the gas varied, although the process was carried on as alike as possible. The gas soon began to come over, and was accompanied with carbonic acid gas, the quantity of which diminished as the operation continued; in one instance the acid at length ceased to come over. The quantity of the gas was much less than from the same bulk of wood or pit coal. It always contained some common air, which varied from 1-8th to 1-4th of the mixture. This mixture of common air was probably owing to the vessels not being air tight.

As washing with water did not separate all the carbonic acid gas, lime-water was used for that purpose. The quantity of common air was estimated by means of nitrous gas; it formed 12 per cent. of the particular gas on which the following experiments were made.

The smell of this gas was similar to that of the gas from pit coal, and most vegetable substances. It did not lose this smell by agitation with water or lime-water; but it was no longer perceptible after the gas had been washed in liquid oxymuriatic acid. This smell is usually ascribed to an admixture of empyreumatic oil, but this opinion has not been verified by any direct experiment.

It is not absorbed by water, nor does oxymuriatic acid gas occasion any alteration in its bulk; it therefore does not contain olefiant gas.

It is very deleterious to animals.

Its specific gravity was 0.8358. that of common air being 1. After standing a month in a trough of water, its specific gravity was 0.8354. but this may be only owing to inaccuracy.

As the gas contained 1-12th of common air, we may conclude that the specific gravity of the pure gas is 0.8128; and hence 100 cubic inches of it, at 60° Fahr. would weigh 25.18 grains under the mean pressure of the atmosphere.

It burns, in the open air, with a beautiful blueish red flame.

When mixed with sufficient quantity of common air, it takes fire in close vessels by the electric spark, and burns with a pale blue flame; with a small proportion of oxygen, it burns with a reddish blue flame: and with its own bulk of that gas, it burns with a fine white flame. Carbonic acid is always produced by this combustion.

A considerable number of experiments were made by Dr. Thomson, on the results occurring after the combustion of this gas, with common air, or oxygen of various degrees of purity, in order to ascertain the effect produced by the presence of different proportions of azote during the combustion of the gas. For the long calculations founded upon the data thus acquired, the chemical reader must be referred to the paper itself, as they are not susceptible of an abridgement. We can only relate the experiments themselves, and slightly advert to the conclusions he draws from them.

Peat gas containing 1-12th of common air, mixed with an equal bulk of common air, does not burn in close vessels by the electric spark. Twenty-one measures of peat gas, with 42 of air, left after combustion over water 54, of which 3 were absorbed by lime-water; the remaining 51, added to 12 of nitrous gas, produced 60 measures. Thirty measures of peat gas, with 90 of air, burned the best of any of these mixtures, and left 92½, which were reduced to 84 by washing, containing 6 of oxygen, 74.2 of azote, and 3.8 of residuary gas. Twelve measures of peat gas with 60 of air, burned with a very feeble flame, and left 61, which were reduced to 59 by lime-water; these 59 mixed with 17 of nitrous gas, produced 55 measures. Great anomalies appear in these results.

If oxygen is substituted for common air, the combustion is more violent, and the detonation louder. If the proportion of oxygen be less than 2-3rds of the gas, the residuary gas will detonate again with fresh oxygen.

Thirty measures of peat gas, containing as before 1-12th of common air, being mixed with eight measures of oxygen obtained from black oxide of manganese, and containing 42.1 per cent. of

azote, did not inflame by the electric spark over water. Thirty measures of peat gas with 12 of the same oxygen inflamed, and left 35, which were reduced to 32, by washing with lime-water. Twelve more of oxygen were used for the second combustion, when 32 were left, which were reduced to 26 by lime-water: to this residuum 20 of nitrous gas being added, produced 43 measures. Thirty measures of peat gas and 16 of oxygen, left 33, reduced by lime-water to 28; these with another 16 of oxygen, left 34, reduced by lime-water to $28\frac{1}{2}$, which with 21 of nitrous gas produced 38. Thirty measures of peat gas and 20 of oxygen left $37\frac{1}{2}$, reduced by lime-water to 32; these with another 20 of oxygen, left 36, reduced by lime-water to 27 which with 31 of nitrous gas, produced 46. Thirty measures of peat gas with 24 of oxygen, left 37, reduced by lime water to 30; these with another 24 of oxygen, left 42, reduced by lime-water to 32, which with 29 of nitrous gas produced 43. Thirty measures of peat gas with 28 of oxygen, left 36, reduced by lime-water to $26\frac{1}{2}$; these with another 28 of oxygen, left 46, reduced by lime-water to 38, which with 36 of nitrous gas produced 46. Thirty measures of peat gas with 32 of oxygen, left 39, reduced by lime-water to 27, to which 32 of oxygen was added, but no combustion took place, nor any diminution by washing with lime-water, these 59 measures added to 44 of nitrous gas produced 47. Thirty measures of peat gas with 36 of oxygen, left 41, reduced by lime-water to 31, which added to 26 of nitrous gas, produced 43.

Twenty measures of peat gas detonated with 40 of another portion of oxygen, which contained 52.11 per cent. of azote, left 38, reduced by lime-water to 28, which with 27 of nitrous gas produced 34. Twenty measures of peat gas with 60 of the same oxygen, left 57, reduced by lime-water to $43\frac{1}{2}$, which with 31 of nitrous gas produced 46. Twenty measures of peat gas with 80 of oxygen in three different experiments left 78-77-77, reduced by lime-water to 61-62-64, which with 48-56-49 of nitrous gas, produced 46-65-58. And lastly, 20 measures of peat gas with 100 of oxygen left 97, reduced by lime-water to 83, which with 62 of nitrous gas produced 64.

From these experiments, assisted by others made over quicksilver, in order to attain greater precision in respect to the quantity of carbonic acid that is formed, Dr. T. concludes that 100 measures of the pure peat gas absorbs 100 of oxygen, and produces 74. 53, or rather 80 of carbonic acid gas, the bulk of the mixture being of course diminished 120 measures.

As the small portions of azote which disappeared in these experiments occasioned some ambiguity, oxygen prepared from hyperoxymuriate of potash, and which contained only $4\frac{1}{2}$ per cent of azote, was employed for the combustion of another portion of peat gas, which contained 23 per cent. of common air. The specific gravity of this gas was 0.8516, whence that of the in-

flammable portion of it may be calculated at 0.8072, of course 100 cubic inches would weigh 25.02 grains at 60° Fahr. and it was about 4 per cent. lighter than the former.

Twenty measures of this peat gas detonated with 20 of the above oxygen over water left 24, these were reduced by lime-water to 20, which on adding 36 of nitrous gas produced 27½. Twenty measures of peat gas with 30 of oxygen, left 37, reduced by lime-water to 30, which with 41 of nitrous gas produced 18. Twenty measures of peat gas with 40 of oxygen, left 46½, reduced by lime-water to 38, which with 54 of nitrous gas produced 22. Twenty measures of peat gas with 50 of oxygen left 55, reduced by lime-water to 47, which with 74 of nitrous gas produced 23. Twenty measures of peat gas with 60 of oxygen, left 65, reduced by lime-water to 58, which with 104 of nitrous gas produced 32.

From these experiments and others performed over quicksilver Dr. T. concludes that 100 measures of peat gas absorbs 104.98 of oxygen, and forms 66.1, or rather 81,4 of carbonic acid. The mean of the above two statements being that 100 of pure peat gas absorbs 102 of oxygen, and forms 81 of carbonic acid gas.

The peat gas does not contain olefiant gas, because its bulk is not sensibly diminished by oxymuriatic acid.

If the peat gas were a mixture of carbonic oxide and carburetted hydrogen its specific gravity would indicate, that it contained 60 per cent. of the former, and 40 of the latter; hence, 100 measures of it ought to absorb 107 of oxygen, and form 94 of carbonic acid gas, which is not the case.

If the peat gas were a mixture of carbonic oxide and hydrogen, its specific gravity would indicate that it contained 83½ per cent. of the former, and 16½ per cent. of the latter; hence, 100 measures of it ought to absorb 46 of oxygen, and form 75.1 of carbonic acid gas, which is not the case.

If, therefore, the peat gas is, as Mr. Henry thinks, a mixture of the inflammable gases already known, there remains only the hypothesis that it is a mixture of carbonic oxide, carburetted hydrogen, and hydrogen. It is obvious that on this hypothesis, the carbonic oxide can never form less than 60, nor more than 83 per cent. of the mixed gas, that carburetted hydrogen can never amount to 40 per cent. nor hydrogen to 16. A number of mixtures might be stated as having the requisite specific gravity, but it is needless to examine the products of their combustion, because none of them approach those of the peat gas, so nearly as the mixture of carbonic oxide and carburetted hydrogen. Indeed, it was at first apprehended that the differences between the products of this mixture and that of peat gas, was owing only to errors in the experiments; but as the results of several trials were constantly the same, this opinion could not be maintained, and it was afterwards found to be inadmissible. Peat gas, therefore, must either be a peculiar compound gas different from any hitherto known, or at least, contain a peculiar and hitherto unknown gas.

The constituents of this gas, may be attempted to be ascertained by assuming the hypothesis, that when a mixture of inflammable gas and oxygen is burned, whatever portions of them disappear are converted into water and carbonic acid gas. The bulk of the carbonic acid that is formed is evident from the experiment itself, and is equal to the bulk of the oxygen employed in forming it; this bulk, therefore, subtracted from that of the oxygen consumed, leaves the bulk of the oxygen that did not form carbonic acid, but combined with twice its bulk of hydrogen to form water. From these data the weight of the carbone and hydrogen may easily be calculated, and will be equal to that of the gas examined, if it consisted entirely of carbone and hydrogen. But if the weight of the gas is superior, it may be supposed that the difference of weight is owing to a portion of oxygen and hydrogen present in the gas, which combined during the combustion and formed water. This mode of analysing the gases, is however, liable to some degree of uncertainty, but the infant state of chemistry does not admit at present of a greater degree of precision. The quantity of carbone may be esteemed equal to 28 per cent. of the weight of the carbonic acid.

Applying this mode of calculation to the combustion of the gas in the last set of experiments, where 100 cub. in. of gas absorbed 105 of oxygen and formed 81.4 of carbonic acid, we obtain for the constituents of pure peat gas, 44 per cent. of oxygen, 42.4 of carbone, and 13.6 of hydrogen.

Some inflammable gases obtained from peat differed very much in their specific gravity and other properties from those hitherto examined.

Some peat was distilled slowly in an iron body, and the gas that came over was received in two different jars. The first that came over contained 25 per cent. of common air, its specific gravity was 0.7274, whence that of the pure gas was 0.6365. The second portion contained 18.3 per cent. of common air, its specific gravity was 0.6883, whence that of the pure gas was 0.6082. Thus these gases approached very nearly to the specific gravity of carburetted hydrogen.

Twenty measures of the first portion of this peat gas detonated over water, with 20 of oxygen containing $4\frac{1}{2}$ per cent. of azote, left 23, these were reduced by washing with lime-water to 19, which with 46 of nitrous gas produced 41. Twenty measures of the same peat gas, with 40 of the same oxygen left 42, reduced by lime-water to 37, which with 60 of nitrous gas produced 33. Twenty measures of peat gas with 60 of oxygen left $61\frac{1}{2}$ reduced by lime-water to 55, which with 118 of nitrous gas produced $63\frac{1}{2}$. In these experiments the whole of the gas does not appear to have been consumed, so that the combustion is most complete when a considerable quantity of azote is present; although the residuum might have been incombustible.

From these experiments, it appears, that 100 measures of this

variety of peat gas, when abstracted from the common air it contains, absorbs 186 of oxygen, and forms 64.30, or rather when corrected by experiments over quicksilver, 70 of carbonic acid gas. Whence on the preceding principles, the gas itself is composed of 46 per cent. of carbone, 34 of hydrogen, and 20 of oxygen. It cannot, therefore, be a mixture of carbonic oxide and carburetted hydrogen, for it is too light to contain much of the former, and forms too little carbonic acid to contain much of the latter.

Twenty measures of the second portion of peat gas detonated over water, with 20 of oxygen, containing $4\frac{1}{2}$ per cent. of azote, left 15, these were reduced by washing with lime-water to 9, which with 27 of nitrous gas, produced 27. Another 20 measures of peat gas with 40 of the same oxygen, left 36, reduced by lime-water to 29, *containing* 20.80 *of oxygen*, 4.73 *of azote, and* 3.97 *of residual gas.* Another 20 measures of peat gas, with 60 of oxygen, left 56, reduced by lime-water to 47, which with 113.5 of nitrous gas produced 59. As the residual gas, was always the same quantity in these experiments, it was probably incombustible, and differed from the gas which was consumed.

From these experiments, it appears, that 100 measures of this variety of peat gas, when abstracted from the common air it contains, absorbs 158.7 of oxygen, and forms 59.01, or rather when corrected by experiments over quicksiver, 60.63 of carbonic acid gas. Whence on the preceding principles, the gas itself is composed of 41.45 per cent. of carbone, 31.25 of hydrogen, and 27.30 of oxygen.

As the gas from peat thus varies in its specific gravity, and in its other properties, it is not improbable that it is a mixture of two gases, one of which may probably be carbonic oxide, but then the other cannot be carburetted hydrogen, for it must be a lighter gas, containing less carbone and more hydrogen. If we supposed it to be a variety of carburetted hydrogen, we might easily calculate what were the proportion of its ingredients, but if it contains oxygen, then we have not sufficient data for this investigation.

Observations.—The experiments here related are valuable, but the deductions from them are already antiquated, and must vanish like the baseless fabric of a vision, before the demonstration of the existence of hydrogen in charcoal, and the diamond. These two bodies have successively filled the place of Lavoiser's hypothetical principle, which he called carbone; but the experiments of Berthollet jun. and those of Robiquet and Vauquelin on the liquid sulphur of Lampadius, of which we shall give an account immediately and the deductions drawn by Biot and Arrago from their investigation of the refractive power of different fluid media, mentioned in our last number, shew that neither of them can be considered as elementary bodies; and therefore all the compounds into which they are stated to enter must be re-considered.

Account of a Memoir, by Mr. Bertholle*t*, Jun. *on the reciprocal action of Sulphur and Carbone.—Ann. de Chim.* No. 182.

Professor Lampadius, in 1796, by distilling martial pyrites with charcoal, obtained a very volatile sulphureous liquid, which he called alkohol of sulphur This he supposed to be composed of sulphur and hydrogen. Clement and Desormes, found that this liquid might be formed by passing the vapour of sulphur through ignited charcoal; and as the charcoal disappeared, and the liquid left some black spots when burnt, they considered the liquid product as a combination of sulphur and carbone; and gave it, of course, the name of carburetted sulphur.

A glass tube was placed across a furnace, in a reclining position, the middle of this tube was filled with well burned charcoal, sulphur was introduced into the higher part of the tube, which was then sealed hermetically, and a set of receivers immerged in a cooling mixture, and furnished with a pneumatic apparatus was luted to the lower end. When the charcoal was ignited, the sulphur was melted, and running down the tube, no sooner came in contact with the charcoal, than a gas was emitted accompanied with white vapours which condensed in the receivers, and fell to the bottom of the water in one of them, in the form of a white oil, which was sometimes yellowish.

The products obtained by this process are very uncertain, as they vary very much according to circumstances. If the production of gas is lessened, the sulphur ought be more heated, in order to make more of it run down the tube; and if this does not succeed, the temperature of the charcoal must be encreased.

To produce a quantity of the liquid, the tube ought to be heated a little above a cherry red, and only a slight excess of sulphur run down. Too little sulphur produces only gas, and a few drops of a liquid lighter than water, which during the operation vanish into gas. If the sulphur is too abundant, besides the gas there is only formed solid hydroguretted sulphur, which Desormes and Clement considered as carburetted sulphur.

When the operation is carefully performed, there is a distinct period to be observed, at which time no more gas is emitted unless the temperature, both of the charcoal and of the sulphur, is encreased.

The gas that passed through the water rendered it milky, and gave it the smell and other properties of water impregnated with sulphuretted hydrogen. The gas itself possessed the same smell, it was soluble in water by agitation, or long continued

contact; it burnt with a blue flame, and exhaled the smell of sulphurous acid; it detonated violently with oxygen, by the help of the electric spark; this combustion sometimes did not render lime-water turbid, but generally formed a slight precipitate, sulphur being deposited. So that it did not differ from sulphuretted hydrogen, except in being less soluble in water: but Scheele, Kirvan and other chemists mention combinations of this kind, that are scarcely, or not at all soluble in water.

The liquor found under the water placed in the receiver, was equally transparent as water, it smelled like sulphuretted hydrogen, but stronger and sharper. It adhered to the sides of the vessel, and greased them as if oily, when shook together with the water. It burned with a blue flame, and sulphureous smell. No charcoal was observed to be deposited in consequence of this combustion: if the combustion was stopped, sulphur only was left. It was very volatile, and produced a great degree of coldness on the skin in consequence; it left on volatilization pure sulphur without any charcoal. It dissolved in air, and augmented the volume of that fluid. The impregnated air burned silently with a blue flame, but did not deflagrate by the electric spark. The contact of water reduced this air to its original dimensions, and the water seemed to have absorbed sulphuretted hydrogen.

The gas produced from this liquid being burned over lime-water did not render it turbid; treated with oxygenized muriatic acid gas it yielded sulphuric acid mixed with muriatic acid; and treated with alkalies, it formed a combination similar to that of the hydroguretted sulphurets.

The liquid was distilled with water, by a very gradual heat. At 36°, a gas came over, exactly resembling sulphuretted hydrogen gas, then a transparent liquid swimming on water, and by the contact of the air, either falling to the bottom or evaporating, and leaving slight traces of sulphur upon the surface of the water. At 45°. the gas ceased to come over, and a liquid heavier than water appeared, whose colour and consistence increased as the distillation advanced. The operation being stopped after a heat of 45°. had been kept up for some time, the residuum was compact, but some prismatic crystals might be perceived in it. Similar appearances may be observed in the original production of this singular substance: liquids of different densities being obtained, some condensed in the first receiver, others in the water contained in the intermediate bottle, and others carried by the gas into the bell glasses.

The sulphur that runs through the charcoal in this operation has a lamellar texture. It is lighter than before, and smells strongly of sulphuretted hydrogen; some of which may be separated from it by a gentle heat. It does not contain charcoal, but sometimes exhibits very slight traces of manganese or of iron, arising from some accidental impurities of the charcoal or

sulphur employed. It ought to be called solid hydroguretted sulphur; the name of carburetted sulphur given it by Desormes and Clement being improper.

It has been long known, that when the hydrosulphurets are decomposed by acids, all the products just mentioned may be obtained.

The charcoal remaining in the tube is externally unaltered, it is very light and friable; it leaves a good black trace, and burns with difficuly; it contains sulphur which may be separated either by solution in alkalies, or by heating the charcoal in the open air.

After the above phenomena have taken place, and the emission of gas is slackened, the augmentation of the temperature, and the running down of more sulphur will bring on a fresh emission of gas, and the charcoal will at last disappear. If the operation is stopped before that term, the charcoal is found corroded. Very little liquid comes over during this time, and even this soon takes the gaseous form, 1 gramme (15 grains) of charcoal, previously heated for an hour in a forge, yielded in 5 or 6 hours, 4 or 5 litres (300 cub. in) of gas.

This gas resembles sulphuretted hydrogen gas by its smell, and its manner of burning, but it renders lime-water turbid when burned over it. It is not entirely soluble in water. It requires an equal measure of oxygen gas to burn it, and it occupies at least 10 times its bulk at the moment of deflagration. It is a triple combination of carbone, hydrogen, and sulphur.

It may, from these experiments, be reasonably supposed that charcoal always contains hydrogen, which is separated at a high temperature in consequence of the superior attraction of sulphur. It also appears probable, when the bulk of the gas is considered, and the attraction of sulphur for hydrogen, that sulphur itself contains hydrogen. Indeed sulphur passed through an ignited glass tube, yielded some traces of sulphuretted hydrogen gas. Again, by preparing metallic sulphurets of iron, copper, and quicksilver, in stone-ware retorts, with great care to avoid errors, sulphuretted hydrogen gas was obtained, especially from the sulphuret of quicksilver. The gas thus obtained was in sufficient quantity to precipitate lead, from its solution, and to be inflamed. Mr. B. repeated the experiment of obtaining sulphuretted hydrogen by passing water over melted sulphur, and was convinced that the water was not decomposed, as not the least sulphuric acid could be discovered. Many other facts of the same nature are known.

Experiments on the Liquid Sulphur of Lampadius. By Messrs. Vauquelin *and* Robiquet.—*Ann. de Chim.* No. 182.

The only precautions necessary to obtain this liquid is to keep the receivers cool. The apparatus used by Mr. Robiquet was a porcelain tube filled with dry charcoal laid across a furnace, to which tube was luted at one end a small retort containing sulphur, and to the other end a set of receivers with some water. When the tube was ignited, the sulphur was heated so as to pass in vapour through the charcoal. While the charcoal only is heated, carburetted hydrogen gas mixed with carbonic acid was continually disengaged, but as soon as the sulphur began to pass, a large quantity of sulphuretted hydrogen gas was produced. After a certain time the emission of gas slackened, and a citron-yellow oily looking liquid came over, which at first swam in drops on the water put in the receiver, but when these drops attained a certain size they fell to the bottom, If the sulphur was volatilized too rapidly, some of it united with this oil and gave it more colour and density ; the remainder was condensed in the receivers. If the first receiver was so near the furnace as to acquire a heat of 20 or 25° Cel. the sulphur boiled, and passed over into the next.

The liquid sulphur thus obtained, becomes perfectly colourless, transparent, and liquid by rectification with a gentle heat, and leaves sulphur in the distilling vessel. The rectified liquid is denser than distilled water, it has a very strong, fœtid, sulphureous, penetrating odour, somewhat like that of garlick and an equally strong taste. It has a very great refracting power.

Exposed to the air, it spontaneously evaporates without leaving any residuum, if it be pure. It catches fire with ease, the flame is white at first, and then becomes slightly purple ; while burning it yields a sulphureous smell, and deposits sulphur on the surrounding bodies.

The water in which the liquid sulphur was received had a milky look, and the vessels were spotted with a deep black substance. This water has the same kind of smell as the liquid sulphur, but weaker. It does not redden litmus. It precipitates many metallic solutions, particularly that of lead, of an orange yellow ; and that of oxygenized quicksilver, of a white; and that of tin, of a brick yellow.

Sulphuric acid, in time, dissolves some of this liquid, and acquires a fœtid smell.

Nitric acid does not immediately unite with liquid sulphur, which swims upon it ; by agitation the liquid sulphur is divided into globules, that are very difficultly brought to run together. On the application of heat a gas is emitted, which does not render

lime-water turbid. This gas burns with a flame similar to that of carbonic oxide, but the combustion is instantaneous, and a piercing sulphureous odour is the consequence of it. If the heat is too violent, all the liquid sulphur passes over. The nitric acid does not acquire the least trace of sulphuric acid.

Oxygenized muriatic acid gas gives the liquid sulphur a citron yellow colour, and that of the gas itself disappears. On opening the vessels, an abundant, very fœtid, arsenical fume is emitted, which takes fire by the contact of flame. The gas well washed also inflames and yields a sulphureous smell, which is so much the weaker as the gas has been more washed.

A mixture of sulphuric and nitric acid diluted with water dissolves the liquid sulphur. Indeed diluted acids seem to have more effect upon this liquid than the concentrated.

Caustic potash acquires in time a colour from liquid sulphur, and then precipitates several metallic solutions.

Ammonia acquires from liquid sulphur a deep yellow colour, and then precipitates several metallic solutions.

Barytes (when dissolved in water) dissolves liquid sulphur, and takes an orange colour; the solution precipitates several metallic solutions.

Alkohol dissolves liquid sulphur in any quantity; the solution is precipitated by water, and the liquid sulphur is separated in globules which sink to the bottom.

Hence this liquid does not appear to contain carbone, but to be a hydroguretted sulphur, unless the sulphur is itself a compound body. The action of the oxygenized acid is remarkable, and seems to indicate a state of sulphur analogous to that of carbone and azote in the carbonic oxide gas, and nitric oxide gas.

Some of the liquid sulphur has been given to Mr. Biot, that he may determine its refractive power, and calculate from thence the quantity of hydrogen that it contains.

Observations.—The experiment contained in this paper, and that of Mr. Berthollet, junior, are doubly important. They make us better acquainted with the combinations of hydrogen and sulphur and they point out the great practical utility of agents, which we would least suppose to have any great effect. The old chemists have, in general, considered acids as the agents on which they could place the greatest reliance in making analyses of compound bodies; and the moderns have adopted oxygen, a substance which is the active and common principle in acids, as at once their principal instrument of investigation, and the basis of their methods in systematizing natural bodies. Here we see a decomposition effected on charcoal, a body which has hitherto resisted all the efforts of chemistry to decompose it, and which had been elevated to the rank of an element by Lavoisier; and this decomposition effected by sulphur, one of the most inactive substances.

REVIEW OF SPECIFICATIONS OF PATENTS,

PUBLISHED IN THE REPERTORY OF ARTS, &c. IN THE MONTHS OF APRIL, MAY, AND JUNE, 1807.

Mr. HENRY FOURDRINIER'S *Patent for a Method of making a Machine for manufacturing Paper of an indefinite Length. Dated July* 1806.—*Repertory of Arts, &c.* No. 59, New Series.

MR. Fourdrinier's machinery for manufacturing paper of an indefinite length, consists of a long horizontal platform, agitated backwards and forwards by a crank motion at the extremity next the paper-vat; along this platform a succession of paper-moulds are made to pass close to each other, so contrived, that their ledges at each end may be removed occasionally, that they may have an uniform surface uninterrupted by any projection: these moulds pass beneath a trough at one side of the paper-vat, over the side of which trough the paper stuff flows down on the moulds, where it is spread out regularly by the agitation of the platform. Holes in the side of the vat, regulated by registers, determine the quantity of paper-stuff that flows out into the trough in a given time; two sets of rollers are described to be placed at the farther extremity of the platform, connected with endless webs of felting, one pair of which takes the paper-stuff off the frames, and the other pair presses the moisture out of it, after receiving it from the first pair, and then delivers it to any fit place of reception. The first roller is mentioned to be so connected with the platform as to participate of its repercussive motion; the other rollers are not supported by the platform, and only communicate with the first by the endless web, which is mentioned to be so placed that its tension shall not impede the requisite motion of the first cylinder, or, of course, that of the platform.

Observations—Of the efficacy of this machinery it would be difficult to decide without having seen it at work; there seems, however, one defect in its construction, to obviate which no way is pointed out, and which, we apprehend, would totally impede its operation; the roller, that removes the paper-stuff from the moulds, is fixed to the platform, and participates in its motion, and is connected with another roller by an endless web, along which the paper stuff passes to the pressing-rollers, which second roller is fastened to some external frame, (it being expressly stated that it is not supported by the platform) and consequently cannot participate in its motion. Now, as one roller has a repercussive motion in the direction of its axis, while the other has no motion but

round its own axis, the endless web which connects them would, we conceive, be twisted and creased by this inequality in the movement of the rollers; and consequently the paper-stuff which passes along this web must be rendered uneven. It appears to us, that either this difficulty escaped the notice of the patentee, or that he has omitted to describe the method of obviating it.

Mr. Henry Fourdrinier's *Patent for a Machine for cutting Paper. Dated July* 1806.—*Repertory of Arts, &c.* No. 59, N. S.

The machine which is the object of this patent is apparently solely applicable to the cutting the long paper formed by the apparatus described in the preceding article, into portions of such sizes as are usually sold in the shops. In this machine, a strong horizontal cutting-knife, fixed to a sliding vertical frame is forced downwards, when required, by a vertical screw, on which a concentrical horizontal-faced wheel is fixed. This wheel is turned by a vertical pinion, the axis of which passing beyond the frame, is attached to a large vertical wheel, which, by the intervention of another wheel in the same direction, is moved by a vertical pinion, which itself is turned by a winch. This machinery causes the knife to move with vast power

A long platform lies beneath this apparatus, over which an endless web is made to pass by rollers at each extremity of the platform; on this web a number of oblong blocks of wood are laid close together, whose use is not mentioned, but which appear to be intended to prevent the knife from cutting the web. A frame, or carriage, supporting a roller, that contains a quantity of the paper to be cut, runs on wheels over ledges at each side of the platform, so that it can be drawn forward near the cutting-press, or removed from it at pleasure. The paper is laid over the blocks in a sufficient number of sheets, or layers, to form quires, reams, or such other quantities as may be wanted, in one parcel.

Observations.—As this machine does not appear to us to be applicable to any general purpose, but to be exclusively confined to the single use above-mentioned, it cannot be of much advantage to enter into any minute examination of its merits. The parts of the cutting-press seem, by the drawing, to be well and strongly combined. The plan of drawing a number of blocks of wood over a long platform by a linen web, we consider not judicious, as the weight of the blocks, and friction, must soon destroy it.

Mr. James Winter's *Patent for a Machine for sewing and pointing Leather Gloves. Dated February* 1807.—*Repertory of Arts, &c.* No. 59, New Series.

Mr. Winter's machine is a kind of wooden vice for holding the leather while it is sewed, the edges of the lips of which have narrow metallic plates annexed to them, deeply indented or engraved, with lines across them at exact intervals from each other, which the stitches of the glove should have between them, and which lines direct the needles in forming the stitches. The lips of this instrument are shaped like those of that used by sadlers for holding the bridles and other work while they are stitching them together; one of the lips is moveable outward from the other on a hinge; a spring presses it sufficiently strong against the other lip to hold the work, and a bar projects from it at right angles, which communicates by a wire with a treadle, by the operation of which it is made to recede from the fixed lip when required.

The indented plates, or indexes, as they are named by the patentee, have their grooves at different distances, according to the kind of stitching for which they are to be used; figures are given of four different species of them in the specification, and particular directions are inserted for all the different kinds of work which is to be performed on them. The whole implement is fixed upright to a moveable foot, or stand, for the convenience of placing it wherever desired.

Observations.—The use of this implement promises to add much to the neatness of the work done on it, to accelerate its performance, and to enable inexperienced hands to work with accuracy; the patentee states with great probability of truth, that the work will be stronger than usual, when done with this implement, and that there will be much fewer loose ends. It will also enable glovers to perform their work standing, if it be raised sufficiently high, which will add considerably to their health, and prevent the ill effects of a sedentary employment. Implements on similar principles, but adapted to the peculiar circumstances of the work, would also be found of considerable use to sadlers, shoe-makers, &c.

Mr. John Fletcher's *Patent for a Composition for Agricultural Purposes. Dated Oct.* 1806.—*Rep. of Arts, &c.* No. 59, N S.

This composition consists of gypsum, selenite, or sulphate of lime, of which the kind called *fibrous gypsum* is the best; and of old oyster shells deprived by time of their exterior black crust,

or of fresh oyster shells cleared of the said crust by a rasp, or any other instrument, to which baroselinite or natural sulphate of barytes is added. These ingredients are all to be reduced to a fine powder, but the baroselinite should be more finely powdered than the rest. To a thousand bushels of the gypsum, one hundred bushels of the oyster shells are to be added, and five hundred weight of the baroselinite. This composition the patentee states will be of great value as a manure, and also destroy the fly in turnips, and snails, slugs, worms, ants, and other insects destructive to vegetation.

Observations.—Gypsum has long been used as a manure, though its effects are very various in different places; its use has had great success in America, but not so much in Europe; whence at a rough estimate, we may presume that it is better adapted for those lands that retain much decayed vegetable matter, than for those in which it is not so abundant. Oyster shells have also been used as a manure for ages, along with other shells; and their composition points them out as good for this purpose, since they contain animal matter as well as lime, both of which are well known fertilizers.

The baroselinite on the contrary is a strong poison, much therefore cannot be expected from it as a manure, but if it destroys the worms, snails, and other insects, without injuring the ground, its use will doubtless be beneficial.

Mr. Joseph Bramah's *Patent for a Machine for Printing. Dated Oct.* 1806.—*Rep. of Arts, &c.* No. 59, New Series.

Mr. Bramah's printing machine is formed by a number of equal disks of wood or metal, arranged close together laterally with a cylindrical axis passing through all their centres, to which they are so secured by a flannel at each end of it, that they only move round in their places, but cannot have any lateral motion, and in this state they look like one solid cylinder. When this machine is intended to be used for typographical printing, the twenty-four letters, the ten cyphers, the stops and other marks, are cut out in relievo on the external surface of each disk; and when a line is to be set for printing, each disk is turned round, till the letter required on its surface comes into the same rank with those already arranged, and when as much of the copy is set, as in the number of letters and stops, equals the sum of the disks, then the paper properly damped is placed beneath the line so set on the disks, and after the ink is applied to it in the usual manner, the whole is forced downwards, so as to give an impression by a screw press, contrived to act on each end of the cylindrical axis at the same time. When the number of impressions required are taken from this line, another is set in the same

manner; and this process is continued till the article wanted is finished.

For copper-plate printing the process is the same as that described, except that the letters or other devices required, are engraved on the peripheries of the metallic disks.

The machine is stated to be applicable to the printing of calico, as well as paper: when intended for this purpose, sprigs, flowers, or whatever other ornamental figures are desired for the pattern, are to be cut on the edges of the disks in relievo; the disks are to be compressed close together by a screw nut on one end of the axis, so as to render them immoveable separately, and make the whole act as one cylinder, from which the impression is to be taken, by turning it round in contact with another cylinder, the calico being drawn between them, in the manner usual in printing calicoes, by cylinders. The colour is to be laid on the cylinder in a manner particularly described by the patentee, but which does not materially differ from the common method, except where a variety of colours are wanted in a pattern, when it is directed that a number of rollers, composed of disks, should be used for the pieces in succession, each having cut on it the parts of the general pattern that are to be of the colour, which is to be applied to that cylinder.

The patentee states that a great variety of patterns may be produced with the same set of disks, as besides the transposition of the figures in a transverse direction, (which is obtained by turning the disks round, in the same manner as those described for typographic printing,) the order of the disks on this axis may also be changed.

The patentee also mentions that an effect similar to that described may be produced, by a number of flat sliders, arranged close together laterally, each having the alphabet, or any other figures wanted, cut on its lower edge: but he prefers the use of the cylinders composed of disks to that of those sliders.

Observations.—Notwithstanding the ingenuity of this invention, we apprehend the slowness with which typographical printing would be executed, and the great inconvenience, and difficulty, which would arise from printing each line separately, it cannot promise any improvement in the general performance of this very valuable art.

In calico printing the change produced in the pattern by the variation of the order of the figures across the piece, caused by turning round the disks partially, would not produce so great an alteration to the eye, as might be imagined; for still the order of the figures length-wise would be the same, as that in which they were cut in each disk separately; and a sameness of design would be evident on first view, though on close examination an alteration of the order transversely could be proved.

Mr. Ralph Walker's *Patent for a mode of making Ropes and Cordage. Dated August* 1806.—*Rep. of Arts, &c.* No. 60. N. S.

In Mr. Walker's engine for making ropes for every strand contained in them, an oblong vertical frame is made to revolve on its centre by machinery, which frame supports as many upright bobbins along its sides as there are yarns in each strand of the rope; in ropes for his Majesty's service an additional bobbin is put at the bottom of each frame to hold the central coloured yarn, called the royal yarn, which marks the ropes.

The frames (which support the bobbins) called flyers by Mr. Walker, are sustained by another frame consisting of a vertical shaft and two cross pieces, in which latter the pivots of the flyers turn; at the bottom of the flyers are placed toothed wheels, which interlock with a large fixed wheel, or periphery of a wheel, whose teeth are at the inside, which when the shaft revolves, causes them to twine round; the upper pivots both of the flyers and shaft are hollow; through the first the united yarns of each strand pass, and then move over revolving rollers to the hollow pivot of the shaft, through which all the strands pass at once to form the rope, and are twisted together by the motion of the shaft; the rope afterwards passes between grooved rollers, put in motion by shafts and wheels communicating with the wheel that causes the main shaft to revolve, and these rollers draw it forward to the place where it is to be coiled up; or, when of a small size, where it is to be rolled upon a reel, moved likewise by the general machinery.

On the main shaft three or more toothed wheels of different sizes are placed, to any one of which the wheel which gives it motion may be applied, so that its speed may be increased or diminished as thought fit; there is a contrivance for the same purpose annexed to the rollers, for drawing out forward the rope, which is very novel and ingenious; a shaft extends from the roller to the wheel which gives it motion; near the roller this shaft has an universal joint, at its further end, where it is to receive its impulse from the revolving wheel; there is annexed to it a segment of a hollow sphere, whose radius is the length of the shaft from the joint to the wheel; on this spherical segment a number of toothed peripheries are fixed, whose centres lie in the line of the shaft, and which increase in size as they are farther removed from the apex of the segment; by this arrangement of parts, any of the toothed peripheries can be brought into contact with the revolving wheel, by merely raising or lowering the end of the shaft: the spherical form of the part on which they are placed causing them all to be at equal distances from their centre of motion, or the universal joint.

A method of tarring the yarns is inserted in the specification of this patent, in which the tar is kept hot by steam entering into the interval between the boiler and an external case, placed at a due distance from it all round, and secured properly to it at top, so as to be air-tight; and an oblong roller is placed horizontally in the boiler, beneath which the yarns are drawn in their passage through the tar, from bobbins arranged at one side of the boiler, by others at the other side, which are turned by bands, and which are filled equally by guides, that are made to rise or fall by a heart wheel movement; the roller that lies in the tar boiler is placed so that it may be raised or lowered according to the quantity of tar in the boiler.

Twelve well executed figures accompany this specification; the three first are different views of the machinery for making the cordage described; the fourth and fifth represent machinery on the same principle for making single strands for large cables; the sixth shews the engines for making large ropes from the single strands; the seventh and eighth figures shew the method of laying small ropes; and the ninth, tenth, eleventh and twelfth figures, exhibit the apparatus described for tarring the yarn.

By this mode of making ropes the patentee states that the yarns will all bear an equal proportion of the strain, and the strands be laid uniformly in the rope, and every strand receive an equal degree of twist, by which the rope will be rendered stronger, and of an uniform degree of strength throughout.

Observations.—Several patents have been obtained for making cordage by machinery; Mr. Edmund Cartwright procured one in May 1792; another was granted in March 1793, to Mr. Belfour, of Elsineur; and in the same year one was also obtained by Mr. Huddart of Islington, who procured a second in September 1804, and a third in October 1805; one was also granted in January 1793, to Mr. Wm. Chapman of Newcastle; and two or three more have been obtained by other persons.

An account is given of Mr. Huddart's second patent in our first volume, page 220, and of his third in our second volume, page 121, where his method is compared with that of Mr. Chapman's, and the merits of both stated. Mr. Huddart's last patent principally regards the method of laying cables from strands previously prepared, as we understand Mr. Cartwright does also; Mr. Belfour's patent, and Mr. Huddart's first and second patents, relate to the preparation of the yarn for the formation of the strands. Mr. Chapman's patent as well as this of Mr. Walker's, includes both the formation of the strands from the yarn, and of cordage from the strands. The chief difference between Mr. Walker's contrivance and Mr. Chapman's, for the formation of the strands from the yarn, is, that in Mr. Chapman's, the reels, or bobbins, which contain the yarn, are stationary as to place, and the twist is given by the revolution of the strand; in Mr. Walker's, on the

contrary, the frames containing the reels or bobbins of yarn move round, and that containing the strand is stationary. Mr. Walker's machine for the formation of the cable or cord from the strands, which his sixth figure describes, appears to us in all essential parts to be the same as that for which Mr Huddart obtained his last patent in October 1805. The engine for which Mr. Huddart's first patent was taken out, was principally for making strands from the yarn, which were contrived to be laid more regularly than usual by it. This differed from Mr. Walker's contrivance in the same manner that Mr. Chapman's did, in having the reels which held the yarn stationary. The differences, which the having such parts stationary cause in the general effect of the machinery, from that produced when they revolve, are stated in the observations on Mr. Huddart's last patent in our 2d vol. p 121

Mr. Walker has omitted to state any method of keeping his bobbins from delivering the yarn too quickly; this circumstance is carefully attended to by Mr. Belfour in his machinery, who has a tolerable good contrivance for this purpose, formed by springs fixed in a peculiar manner to the bobbins, which however obviously admit of some simplification.

The sections of the frames for supporting the bobbins, annexed to Mr. Walker's patent, have a remarkably neat appearance, and shew a very ingenious arrangement of the parts; the accompanying machinery seems also contrived in a masterly manner, and contains a mechanical novelty which may be useful in other engines, in the contrivance of the shaft with the universal joint, and spherical termination, (described near the end of the account of the specification,) for regulating the speed of the rotation of certain parts of the engine to the degree required.

Dr. JOHN CAREY'S *Patent for Contrivances for Preventing or Checking Fires. Dated August* 1806.—*Repertory of Arts, &c.* No. 60, New Series.

DR. CAREY'S Specification describes eleven different articles, for which he claims the Patent-right.

1st. A Shower-bath for Apartments, Warehouses &c. The object of this is to extinguish casual fires. It consists of a cistern placed above the apartment, with pipes proceeding from it in various directions, each terminated by a perforated top, like that of a watering-pot: the cock that admits the water from the cistern into the pipes is so contrived, by a weight appended to it in a particular manner, that on letting go a string, the water runs through the pipes and is discharged copiously over the apartment; this string is brought down over pulleys so as to lie across the floor in different directions. By which means if any part of the floor should take fire, the string will be burnt through

in the part next it, and thereby the cock permitted to open, and the water to fall on the floor.

2d. A chimney shower bath. This shower bath is placed in the upper part of the house; and has a cock, kept shut by a weight, which is opened on pulling a wire, and discharges a shower of water down the chimney, to extinguish its flames when on fire.

3d. A chimney stopper of wood or metal, to close the lower aperture of the chimney when on fire.

4th. A damper gridiron; whose bars may be taken out to be cleaned by taking off a transverse bar, passing behind a projection or through a groove in each of them; a deep rim rises round the gridiron in every part but the front. On this gridiron the patentee declares, it will be impossible either to smoke or singe the meat, so that the constant attendance of the cook may be dispensed with; and that no fat can fall in the fire from it; by which the danger of the chimney taking fire from this accident is prevented.

5th. A lock-lantern for stables, nurseries, &c. There is nothing peculiar in the construction of the lantern. But it is to have a padlock attached to it, with two doors over each other, similar to those that are on some spring padlocks for portmanteaus; between these doors a piece of paper or cord, called a *shield* by the patentee, is to be placed, which, it is so contrived by the arrangement of other parts of the lock, must be torn before the lock can be opened; by which means if a false key or pick-lock has been used in the absence of the owner, it cannot escape notice.

6th. A fire gown or cloak, made of cloth or leather, or other stuff little acted on by fire, lined with the same, and quilted with a stuffing between of hair or wool.

7th. A soot-trap for chimnies: consisting of a tube or box twelve inches in diameter, with a grated bottom, in which gravel, small pebbles, coarse stone-cutters rubbish or metal chain is put; the chimney is so constructed that the smoke can only pass through this tube: the soot will adhere to its contents; and may be cleared from it by washing when the tube is taken down for this purpose.

8th. A soot-trap stove, or a stove to which the principle of the last mentioned article is adapted, in two or three different modes.

9th. A chimney trough. This is another species of soot-trap, to be placed above the back of the fire place. A vertical ledge, with its lower edge perfectly horizontal, descends a little way down, from side to side, in the middle of this trough; the passage of the chimney is so constructed that the smoke can only pass beneath this lodge through the trough, which is filled with water sufficiently close to the ledge just to let the smoke pass,

and is kept full to this level by a ball-cock and pipe, communicating with a reservoir.

10th. A chimney damper, consisting of a double piece of hair or woollen cloth, stopped between with hair, wool or spunge, and quilted. When the chimney is on fire, this damper is to be wetted with water, hung against the chimney opening, and kept wet till the fire is extinguished.

11th. A water candlestick, which is formed by an upright tube to hold the candle, placed in the middle of a pan or basin, six or more inches deep: the diameter of the tube is to be proportionate to the size of the candle to be used, it is to be at least half an inch lower than the margin of the pan, and is to have a hole near the bottom to admit the water.

Observations.—The contents of this specification are perhaps the most multifarious and heterogeneous of any we have yet seen, and required much art to bring them within the limits of the Patent. And even then some of the articles we fear can hardly maintain their title to novelty.

The first soot-trap, in which the smoke has to force its way through a mass of gravel, or chain, would no doubt strain all smoke that could pass through it; but we think this would be little or none, and that the smoke, being of an obstinate nature, would prefer descending into the apartment to the labour of working its way through the other passage.

The chimney damper, No. 10, can scarcely be called an invention; who has not heard of the expedient of applying wet blankets before the fire-place of a chimney on fire?

We think the water soot-trap, No. 9, not merely the best article in the specification, but one, which with some little additions might be of real utility, in saving the trouble of sweeping chimnies; we shall suggest one improvement; which is to add a second ledge as broad as the breadth of the trough will allow, admitting a free passage for the smoke, placed horizontally at the bottom of the first ledge; this would prolong the contact of the smoke with the water: where the chimney would admit of it, the extent of the trough from front to rear might be enlarged, to admit of this ledge being the broader, which would increase this effect.

Mr. William Hance's *Patent for rendering Beaver, and other Hats, Water-proof. Dated Jan.* 1807.—*Repertory of Arts, &c.* No. 60, New Series.

Mr. Hance's patent hats are formed of a body of willow, or some other material sufficiently stiff to retain the shape intended

for the hat; and over this a thin *shell*, or covering of beaver is cemented by water-proof varnish.

The shell of beaver is to be made water-proof, before it is cemented to the willow body, by first laying on a coat of size over its internal surface; over which, when dry, another coat of strong copal varnish is to be put: and over this, when thoroughly dry, a third coat of boiled linseed oil, very strong, or of a very drying quality. The thin beaver is then to be cemented to the willow, by a mastich composed of one pound of gum senegal, one pound of starch, one pound of glue, and one ounce of beeswax, boiled in a quart of water; it is after this to be put on a block and left on it till dry.

The rim is made separate from the crown in a similar manner to that described, only that the willow has a plate of beaver cemented to its under side, as well as to its upper surface, or one of silk shag which will be lighter and look better. The crown and rim are to be strongly sewed together, and afterwards be put on a block to give them their due shape, and the edges of the rim be varnished with copal varnish and strong linseed oil, to prevent rain from penetrating.

Observations.—In Nov. 1794, Mr. George Dunnage took out a patent for the well known silk-water-proof hats, the specification of which is inserted in the Repertory of Arts, Vol. 4; and we suspect that the construction of these hats suggested to Mr. Hance the method for which he has obtained this patent. A coat of thin beaver is substituted by Mr. Hance for the silk shag used by Mr. Dunnage; in other respects the two processes differ but very little.

Mr. Hance states, that his hats being prepared without any glue, they will be free from the injury which rain causes to common hats by sticking down the nap, and making them appear old and greasy. Mr. Dunnage's hats have also the same advantage, and ought to be lighter than Mr. Hance's: the chief fault of the silk hats is, that the stiffening of the crown forms a sharp angle round the top, in which place they are injured by common wear much sooner than in other parts; this might probably be prevented by forming the top and sides of the crown of an intire piece of willow work, prepared purposely for this use, without any joinings.

Messrs. Eckhardt *and* Lyon's *Patent for a new Method of Manufacturing Pipes for the Conveyance of Water. Dated December* 1806.—*Repertory of Arts, &c.* No. 60, New Series.

In this new method of manufacturing pipes, they are formed of separate staves, in the manner of cooper's ware, connected together by hoops of a strength proportionate to the pressure of water, which the pipes are to bear; the pipes either taper in one direction like a churn, or both ways from the middle like a barrel; and the hoops are either driven on them in the same manner as they are on casks, or else are drawn tight on them by screws or wedges; in the latter case the pipes may be of the same diameter in all parts.

When additional tightness is thought necessary, the edges of the staves may be grooved and tongued, and the joints well painted just before they are closed.

The different pipes are to be fitted together by tapering the end of one, and enlarging the cavity of the extremity of another to fit it The patentees direct also that the insides and outsides of the pipes be painted, or covered with pitch, tar, or other cement, or varnish, to make them more securely water-tight, and preserve them longer from decay.

Observations.—If the expense of pipes made in this manner with staves sufficiently thick to last for any considerable time, would not exceed on account of their more expensive workmanship, the cost of pipes bored from the solid, we apprehend this will be a useful and valuable invention. Pumps, however, have been made of separate pieces hooped together, from a very early period.

As the patentees direct the insides of the pipes to be painted, it may be as well to remind the reader that, as white lead, or some other poisonous material, forms the chief article of the composition of most pigments, paints in general are objectionable in pipes for conveying water; Spanish brown, or some of the other paints of which iron oxide forms the sole colouring matter, should be the only exception; but even these are not entirely free from lead, as the oil used with them will probably contain some portion to render it of a drying nature.

Mr. Richard Friend's *Patent for Improvements in Gun-Carriages, &c. Dated Jan.* 1807.—*Rep. of Arts, &c.* No. 61, N. S.

Mr. Friend's gun-carriage runs on slides, similar to those used for carronades, it has four wheels beneath it, and is so contrived

that it may be either made to rest on the wheels, or slide without them, as thought fit, by merely pressing down two iron bars; the wheels are raised and lowered by levers, on whose terminations segments of toothed wheels are fixed, which communicate with pinions turned by the bars above mentioned. The patentee states that this construction will enable two men to run out the gun without tackle-falls or hand-spikes, and to haul it in with ease, if it should not return sufficiently in the recoil to admit of its being loaded where it stops.

The contrivance will also be of use for rope-makers sledges, or for any other heavy apparatus that is wanted to lie sometimes on a flat surface, and at other times is required to be moved.

Observations.—We think this contrivance will be of considerable utility at all times for garrison guns, and for ship guns, whenever the pitching and rolling of the vessel shall not be so violent as to alter the inclination of the support of the guns with too much rapidity to admit of the change from the slide to the wheels being made, so as to follow it to advantage.

Mr. John Maberly's *Patent for making Tents, Tent-Poles, and other Machinery, so as to carry off noxious air. Dated March* 1807.—*Repertory of Arts, &c.* No. 61, New Series.

Mr. Maberly's contrivance for ventilating tents, relates chiefly to those called bell-tents; the central pole of which is made hollow near the top, where it communicates with an external hollow vessel, shaped like a mushroom, that rises above the tent, and by apertures under its projecting edges, admits a free passage to the heated air, that enters the hollow part of the pole by perforations formed in it from the tent.

The conical termination to the pole prevents rain entering into the tent, by the passages for the air.

The hollow part of the pole is made to separate from the rest by a socket joint for the convenience of carriage.

Mr. Thomas Paty's *Patent for a Method of Spinning, Dyeing, Weaving, and Manufacturing East Indian Sun-Hemp into Carpets, and Carpet-Rugs. Dated April* 1807.—*Repertory of Arts, &c.* No. 61, New Series.

In Mr. Paty's specification, the sun-hemp is directed to be taken from the bale, and dressed into three sorts on a *rag* and *cleaver*. The first and longest sort is to be used for spinning yarn for the warp; the second sort, for the yarn that is to form the

pile of the carpet, and the third sort, for the yarn of the shoot or weft. The yarn is then directed to be dyed in the skain of various colours, (of which eleven are specified, and all other possible colours declared to be intended,) by means of various dyeing stuffs, of which twelve are particularly mentioned, but all in common use; and no process whatsoever is inserted for dyeing the sun-hemp in any of the colours specified by these dyeing stuffs. The yarn after being dyed is directed to be woven in a loom, all the parts of which are particularly described, but which in no respect, that we could perceive, differs from a common loom; a steel reed is to be used, and the pile is directed to be formed over a rod, which may be of various dimensions, under two inches round, according to the length of the pile required, and is to have a groove in it about three eighths of an inch deep; the yarn is to be wound round this rod by hand, being threaded through every two threads of the chain or warp, and when struck up by the batten, is to be cut with a sharp instrument down the groove of the rod, by which means the rod is immediately extricated from the yarn, the cut ends of which form the pile; the rug is finished by clipping and trimming the pile with a pair of shears.

Observations.—An invention must be new in order to entitle it to the benefit of a patent. In Mr. Paty's specification no novelty whatever is discoverable. The mode of manufacturing the hemp is in common use; that of making the pile is no less so; and no mode of dyeing is specified; though Mr. Paty "claims particularly the application of the art of dyeing the sun-hemp various colours as his invention."

Mr. Ambrose Bowden Johns' *Patent for certain compositions, and a Mode of Manufacturing the same, for covering and facing Houses, and other useful purposes. Dated December* 1806. *Repertory of Arts, &c.* No. 61, New Series.

Four receipts are given for these compositions, which vary but little from each other. In the first it is directed to "take powdered lime-stone, or other stone, or what is preferable, *road-stuff*, where stone is used in making and repairing the road. This is to be sifted through a sieve, of moderate fineness so as to let a sufficient quantity of sand pass with it. The quantity of sand contained is to be known by washing the powder in clear water until it is deprived of its earthy particles; the proportion of sand should never exceed one half, otherwise the composition will be too short. To six gallons of this powder one quart of lime recently slacked is to be added, and a pint of the powder of burnt bones; the whole of the materials are to be

well mixed together, and put into a boiler, and made dry and warm; then two gallons of tar, pitch or resin are to be added, (but the tar is preferred by the patentee,) and the materials are to be boiled to a sufficient hardness for the purpose required; great care must be taken to prevent the mixture from burning by constantly stirring it; for which purpose an apparatus is invented, of which a figure is annexed to the specification.

In the second receipt, whiting, slacked lime, or powdered chalk is directed to be used, with as much sand as will give sufficient hardness, in the proportion of three gallons to one of the tar, pitch, or resin: the whole to be managed as already described.

Receipt 3d. Powdered clay and sand as before, two gallons and one quart, and slacked lime one quart, are to be added to two quarts of tar pitch or resin, and boiled as before directed.

Receipt 4th. To any calcareous or earthy substance, with as much sand as can be put in without destroying its tenacity, add a fourth part of any bitumenous substance, and manage as before.

When the above mixtures are boiled, they are to be toughened by beating into them hair, hemp, or any other material of the like nature, in the same manner as hair is usually mixed with mortar, for plaster: this operation is to be performed on a hot plate; and the materials are directed to be "*mounted*" on paper, cloth, or some similar substance.

The mixture thus prepared is formed into sheets by working it into a long roll on a sheet of lead, placed on the hot plate before mentioned, beating it out into a flat sheet, and then passing an instrument, called the preparatory roller, of which a section is annexed to the specification. It is after this passed between a pair of rollers, on a board, which is placed beneath the lead-plate; cutters are fixed to the frame of the rollers which divide the sheets into the sizes required.

Observations.—Many years ago a composition of the same nature, as that of this patent, was used in Sweden for roofing houses, and called Swedish stone paper: Mr. George of St. Petersburg afterwards imitated it perfectly well by a mixture of two parts in weight paper-pulse, of one part glue, six parts white bole, two parts chalk and three parts linseed oil, and he tinged it of the colour of slate with $\frac{1}{8}$ part of Prussian blue; this produced a plate very firm and elastic, which suffered no change during a year in which it was exposed to the weather.

Mr. Johns, in his composition, directs *road-stuff* to be used; this seems to be a favourite article with composition makers; we have before deprecated the use of such an indefinite term for so variable an ingredient, when proposed by Mr. Vanherman, see vol. 2. p. 436, and must repeat our objections to it here on the same account.

Mr. Wm. Lloyd's *Patent; for an Invention of Antifriction Rollers to assist Carriage Wheels. Dated Nov.* 1806.—*Repertory of Arts, &c.* No. 61, New Series.

These antifriction rollers are of the common form, used for dipping needles, and other nice instruments; and consist of four vertical disks, placed in pairs opposite each other, at the different ends of the axis whose friction is to be diminished by them. These friction rollers, or disks, are directed by Mr. Lloyd to be *half* the diameter of the carriage wheels, to be placed above them in proper frames described by him, and to run on gudgeons fixed in them and turning on centres, supplied in some cases with oil by an oil-box placed above them: the carriage wheels are to turn round on the axle-tree in the usual manner, besides having the axle-tree moveable beneath the friction wheels: but a catch is directed to be added to them to fasten them to the axle, and make both turn together; the use of which it is rather difficult to conceive.

Sixteen figures are annexed to the specification, of various parts of a carriage fitted with these antifriction disks, and of some different sorts of those disks, varying only in having spokes or being plain; in being convex, or concave at the sides.

Observations.—The use of friction rollers of this species is a very old invention; figures of them may be seen in Dr. Desaguilier's Natural Philosophy published in 1763, which were taken from other works of a more remote period. To the best of our recollection, vertical friction rollers were used to the well known carriage, which was drawn by race horses against time many years ago at Newmarket; pictures and prints of it are very common, one of which was for many years hung up at the Royal Oak Inn at Woolwich, and probably is there still.

This print is however of no great consequence, since the use of friction rollers is of such very small importance on common roads, as we have already shewn in our observations on Mr. Tates patent friction wheels in our first volume, page 231.

Mr. Lloyd's friction wheels have the additional disadvantage of adding considerably to the weight of the carriage, from the large size of which they are directed to be made, which is no less than half the diameter of the carriage wheels.

NATURAL PHILOSOPHY, ARTS, AND MANUFACTURES

Extract of a Memoir on two new Classes of Galvanic Conductors. By Mr. ERMAN, *of Berlin.—Ann. de Chim.* No. 182.

THIS essay has been honoured at Paris with the annual prize which is allotted to the subject of Galvanism. It contains an account of the singular properties of two kinds of substances with respect to galvanic electricity. These substances appear to be perfect conductors of the electricity excited by the galvanic apparatus in every other respect than in their inability to complete the circuit by connecting the opposite poles; and some of them, when thus situated, still appear to transmit very readily the electricity of the positive pole; others on the contrary, that of the negative pole. Hence Mr. Erman calls them conductors unipolar, in contradistinction to those imperfect conductors, which according to his theory, are bipolar, the effects of each pole of the battery influencing separately the half of the substance which is nearest to it. Thus, he observes, glass, roots, ice, steam, sulphur and its flame, and amber, are perfect nonconductors of galvanism; metals are perfect conductors: water and moist substances are bipolar imperfect conductors; the flame of hydrogen and of hydrocarbonated substances are positive unipolar conductors; and the alkaline soaps, and the flame of phosphorus are negative unipolar conductors.

The experiments, on which Mr. Erman's opinions are founded, are thus described: a strong battery being well insulated, a very sensible electremeter of gold leaf is applied to either of the poles: the flame of a spirit lamp, which is also insulated being connected with the other pole, the electremeter is not affected; but when the flame is made to communicate with the ground, the divergence of the electreter immediately shews that the insulation of the opposite pole is perfectly destroyed. The conducting power of the flame for the electricity of either pole may also be shewn by interposing it between the battery and the electremeter, the same degree of divergence being indicated as if the communication were made by means of a wire only. But when the poles of a strong battery are both furnished with electremeters, and when a connection is made between them by means of flame only, they are still found to remain perfectly insulated, and they exhibit very nearly, or precisely the same effects as if the flame were removed. Hence it had been affirmed that flame was a perfect nonconductor of galvanism; but it is easily shewn that the insulation is only partial; for upon plunging a rod of metal into the flame, the positive pole is discharged, and the electremeter of the negative pole exhibits its greatest divergence. And if for the flame of spirits that of phosphorus, or a piece of dry soap be substituted, effects

of the same kind will be produced upon the opposite species of electricity, the negative pole being discharged, and the positive retaining its electricity unaltered.

Observations.—These experiments are related in so clear and simple a manner, and the known character of Mr. Erman, as a galvanic philosopher is such, that it would be an unwarrantable scepticism to deny their accuracy; nor is it probable that the prize would have been easily adjudged to this essay, without some examination of the facts advanced in it. These facts are however of a nature so extraordinary, and appear to disagree so much with all the received opinions respecting the transmission of electricity, that all we can do respecting them, is to admit them in silent submission, and to wait for some further investigations which may hereafter tend to reconcile them with the inferences from the great mass of experiments and observations which are already known. We are acquainted but with one fact which seems to bear any analogy to them, which is that the flame of a candle is generally found to be driven from a positive toward a negative ball, when a shock or spark passes between them; so that it seems as if the flame admitted more readily the positive electricity, and were in consequence repelled by the one ball and attracted by the other; and it is indeed difficult to explain this experiment upon any other supposition.

On the Precession of the Equinoxes. By the Rev. Abraham Robertson, *M.A. F.R.S. Savilian Professor of Geometry in the University of Oxford.—Phil. Trans.* 1807.

After observing that although the investigations of Newton respecting this subject, evince the same transcendent abilities as are displayed in other parts of his immortal works, yet it has been justly asserted that he made a mistake in his process, which rendered his conclusions erroneous. The author continues to remark that, "since the detection of this error, some of the most eminent mathematicians in Europe have attempted solutions of the problem. Their success has been various; but their investigations may be arranged under three general heads. Under the first of these may be placed such as lead to a wrong conclusion, in consequence of a mistake committed in some part of the proceedings. The second head may be allotted to those in which the conclusions may be admitted as just, but render edso by the counteraction of opposite errors. Such may be ranked under the third head, as are conducted without error fatal to the conclusion, and in which the result is as near the truth as the subject seems to admit. The authors of those investigations, of *each of the three classes,* are entitled

to much praise. Their productions afford the most unquestionable proofs of *great talents, great zeal,* and *great perseverance,* exerted in the cultivation of science."

After this remarkable exordium, which although by no means ludicrous, cannot be called very explicit, with respect to the literature of the subject, Professor Robertson proceeds to observe that most of the errors and obscurities which have occurred in the labours of former mathematicians have arisen from the uncultivated state of the doctrine of compound rotatory motion. He then enters at large into the solution of the problem, and arrives, by a method not materially different from that of Simpson and Lalande, although perhaps in some respect more perspicuously and demonstratively stated, at a conclusion precisely the same as that which these astronomers have already obtained. He calculates upon the implied supposition of the uniformity of the earth's density, and taking the proportion of the diameters as 230 to 231, that the annual precession, caused by the disturbing force of the sun is 21."0336. It will not be expected, nor perhaps desired by our readers, that we should follow Professor Robertson through every step of his investigation, although if it were required, we have no doubt that it would be very possible to compress all the essential parts of this paper, into the compass of a very few pages.

Observations.—We do not profess to consider Professor Robertson's essay as wholly unworthy of a place in the Philosophical Transactions, since it may possibly tend to throw some little light on an obscure subject; but we could have wished, for the honour of the University of Oxford, that something more masterly had been exhibited by its professor of geometry. The elementary difficulties which are here combated, have, in fact, been long since removed by a variety of authors: and it would naturally have been expected that the professor should have gone on to examine in the first place, the effect of the ellipticity of the earth's orbit, which must necessarily be very sensible; secondly, the consequences of the variation of the earth's density, which are still more perceptible; thirdly, the comparative effects of the solar and lunar forces, as inferred from the phenomena of the tides, and as applied to the precesson actually observed; and fourthly, the small, but still perceptible actions of the nearest and largest of the planets. All this, however desirable, we have no absolute right to demand; but supposing that nothing new has been performed, we have the more reason to expect that whatever is advanced should have been carefully and rigidly scrutinized. This does not appear to have been done in every instance throughout the paper. "From the general expression," says the author, (p. 82) "obtained in article 24, it is evident, that when the sun is in either of the equinoctial

points, the nutation became equal to 0. Supposing therefore the earth to be subject to no other disturbing force than that of the sun, at each of the equinoxes the earth's diurnal revolution is made about its axis of figure." Now this general expression is a fluent, which has not been corrected by the addition of a constant quantity, and every student knows that an argument founded on the vanishing of such a fluent is wholly inadmissible. If therefore the assertion had even been true, the mode of reasoning would still have been faulty: but as it happens, the conclusion appears in this case to be erroneous. It may easily be collected from the elementary principles here laid down, that the temporary axis of rotation must describe a small oval figure, its motion being from west to east, and being directed towards the pole of the ecliptic at the vernal equinox, when it is at the eastern extremity of the greater axis of the oval. This oval, therefore, must naturally have the true axis of the earth for its centre, and at the equinoxes, although the nutation vanishes with respect to the plane of the ecliptic, the temporary axis of rotation is the most remote from the real axis of figure.

On the Decomposition of Light into its most simple Elements. By C. A. Prieur.—*Ann. de Chim.* No. 177.

This interesting essay is a continuation of the memoirs communicated to the National Institute in 1805, and 1806, (see Retrospect vol. 1. p. 312.) The Author not being able to read it to the Institute, on account of his absence from Paris, determined to commit it at once to the press. His particular object has been to complete the analysis of light by means of the properties of coloured bodies, with or without the assistance of the dispersive powers of transparent substances.

After mentioning with the highest respect the name of Newton, he answers the inquiry respecting his opinion of the distribution of the light of the spectrum, by asserting that Newton did not consider the spectrum as composed of an infinite number of heterogeneous elements, passing insensibly into each other, but as consisting of light of seven distinct species only, separated from each other by well marked divisions; and he says that the truth of this description may be proved by forming in the usual manner a coloured spectrum, not too narrow, on a wall, or by looking simply at the full moon through a prism; and that in both these cases some of the divisions between the colours will appear perfectly decided. He observes also that the coloured terminations of a white object of considerable breadth, viewed through a prism, are divided by very distinct lines, separating at

one end the red from the yellow, and at the other the blue from the violet; and that when we look through a prism at a very small or narrow luminous object, we see three colours only, red, green, and violet, with very little perceptible variation or mixture of tints. These phenomena he considers as incompatible with the supposition of a regular and gradual change of the nature of the colours throughout the spectrum, but perfectly reconcileable to the Newtonian doctrine of seven primative colours, which may actually be produced in proper circumstances of refraction.

Mr. Rochon's observations on the light of the fixed stars are quoted as strongly confirming these experiments.

This ingenious philosopher examined with a variable prism of his own invention, and with an excellent telescope, the light of the star Sirius, and found that it was composed almost entirely of three colours, red, green, and violet, with a very little yellow, and a slight variation of tint at the confine of the green and violet. Upon increasing the angle of the prism from 14° to 50°, the thickness of the glass became so great as to absorb all the colours in succession except the greenish yellow, or straw colour.

After some remarks of little importance on the achromatic glasses of Dolland and Blair, Mr. Prieur recapitulates what he considers as the principal points that have hitherto been established by opticians. "The rays of light," he says, "are of different colours in all the different parts of the spectrum, and this colour cannot be changed by a new refraction. The Newtonian divison, into seven classes, agrees with a great number of phenomena; but many bodies alter, by their refractive properties, the distribution and proportion of the different parts of the spectrum." He then proceeds to observe, that he had before announced to the Institute his discovery, that all coloured bodies transmitted, when sufficiently increased in thickness, either, red, green, or violet rays alone. Hence it occurred to him, that it was possible to explain the composition of colours of every kind, by the combination of these three kinds of light; while all former attempts of a similar nature, have proceeded, as he asserts, on the supposition of red, yellow and blue.

This supposition of three colours, Mr. Prieur observes, is not inconsistent with the gradual formation of all the shades of the spectrum, nor with the immutability of each shade by a second refraction: for example, a red and a green ray may be equally refrangible, and by their mixture may make a yellow; hence they must remain inseparable by any subsequent refraction. He then states the hypothesis which it is his principal object to establish, that the spectrum may be considered as composed of three different spectra, the red, the green, and the violet, and that these parts are not simply contiguous, but that they encroach more or less on each other, according to the circumstances of the refraction. He supposes that the intensity

of each of the three colours is so varied, that, where the orange appears, the red is mixed with a smaller quantity of green, and where the yellow is found, with a larger; and in the same manner that the blue and indigo are composed of the green and violet, united in different proportions. And in this manner, he observes, that the production of white light by means of rays, taken from two points of the spectrum only may be understood. For examining the effects of such combinations, he constructs a diagram, which he imagines to represent the intensity of one of the three colours by the distance of two circles differing a little in magnitude, and touching each other at a certain point, where the colour is supposed to vanish; and placing two more circles of the same size as the outer, so as to touch the inner one at two other points, situated at the distance of one third of the circle from each other; and from the first point, he conceives, that the proportions of the three simple rays at each part of the spectrum may be expressed by the distance of the outer circles from the inner one at a corresponding part of its circumference.

In order to verify this hypothesis, Mr. Prieur made some experiments with an apparatus which was somewhat unnecessarily complicated, and he mentions M. M. Berthollets and Mr. Laplace, as having being present during a part of his observations. The spectrum was sometimes rendered so narrow as to present to a spectator the image of two lines meeting each other at a small angle, a circumstance which depended on the refractive powers of the eye. The separation of the spectrum into seven classes of colours was perceived, but the divisions could not easily be traced.

The most important of Mr. Prieur's experiments on the spectrum were performed with three glasses, filled with ammoniacal solution of copper for transmitting a violet light, muriate of copper for green, and red wine or tincture of cochineal for red. A small portion of a very extensive spectrum was suffered to pass through a perforation in a screen, one seventh of an inch in diameter, and the circular spot thus formed, was found to consist of light not further separable by refraction, for when viewed through a prism, it was not in any degree distorted. A portion of the most intensely blue light, thus transmitted, was made to pass through the green liquor, and the spot became immediately green, although its brightness was extremely diminished. Upon substituting the violet bottle, the spot became violet; and in the same manner a yellow spot was shewn, by means of the red and green liquors, to afford a portion light of each of these colours.

These experiments were afterwards repeated with a slight variation, the spot of light being thrown on a screen of stiffened muslin, and viewed from behind through coloured glasses or fluids. When the spot was blue, and the coloured substance red, no light

at all could be perceived ; and with an orange-coloured glass, the blue spot appeared of a pure green.

The production of colours in natural bodies may be explained, according to Mr. Prieur, by the elective attraction of particular substances for particular kinds of light, and the absorption of one or more of the three kinds of rays, in various proportions, so as to leave the remaining constituent part of white light to be reflected.

A pencil of the light of the spectrum was suffered to pass through a perforation at the confines of the green and the blue, and was thrown, by means of a metallic speculum, on the extremity of the red light : the combination of these two portions afforded a decided and brilliant white ; hence the author infers, that if, as there is every reason to suppose, the presence of three kinds of rays is necessary to the production of whiteness, it must be allowed that the greenish blue light contains a certain portion of violet rays.

Observations.—The first enquiry to be made respecting an essay which is advanced as tending to the improvement of any branch of science, must naturally be, how far it has a claim to novelty ; for if the attention of the philosophic world has always been sufficiently alive to the investigation of nature, it is to be presumed that those facts and opinions which have been before asserted, have already been sufficiently discussed, and that they do not require to be again subject to criticism ; besides the individual claim of every original inventor or observer to have his theories or discoveries equitably estimated and fairly appropriated. It does not certainly follow that every repetition must be the result of plagiarism, but it appears to argue either inability, indolence, or presumption, when a proper attention has not been paid to the examination of the labours of our predecessors, even if we be acquitted of the dishonourable intention of wilfully assuming to ourselves the credit due to another.

Mr. Prieur has found that in a very narrow prismatic spectrum, the colours principally observable are the red, the green, and the violet. Mr. Rochon, according to his own account, had made the same remark on the light of the fixed stars; and Dr. Wollaston, with much greater accuracy, had assigned the limits of the red, the green, the blue, and the violet, which, with a very narrow line of yellow, he found to be the only colours really entering into a spectrum perfectly simple ; and which, contrary to the opinion of Dr. Blair, he asserts are always in the same proportion, whatever may be the nature of the refracting medium. (*Phil. Trans.* 1802.)

The theory of the composition of all coloured light from red, green, and violet rays, in contradistinction to the older opinion of red, yellow, and blue, is certainly not new, for it was advanced by Dr. Thos. Young in the Philosophical Transactions for 1802, in consequence of Dr. Wollaston's observations on the division

of the spectrum, and it has since been more fully explained in his lectures on natural philosophy.

Dr. Young's theory is, however, by no means perfectly identical with Mr. Prieur's; the distinction of three colours relating, in Dr. Young's opinion, merely to the sensations, and not to the essential nature of the rays. "It is certain," says Dr. Young, "that the perfect sensations of yellow and of blue are produced respectively by mixtures of red and green, and of green and violet light, and there is reason to suspect that those sensations are always compounded of the separate sensations combined; at least this supposition simplifies the theory of colours; it may, therefore, be adopted with advantage, until it be found inconsistent with any of the phenomena; and we may consider white light as composed of a mixture of red, green, and violet only, in the proportion of about two parts red, four green, and one violet, with respect to the quantity or indensity of the sensations produced." "The blue produced by combining the whole of the green and violet rays, is not the blue of the spectrum, for four parts of green and one of violet make a blue differing very little from green, while the blue of the spectrum appears to contain as much violet as green; and it is for this reason that red and blue usually make a purple, deriving its hue from the predominance of the violet." *Lectures on Natural Philosophy and the Mechanical Arts.* Vol. I. p. 439, 440.

The idea of different spectra, composed of rays nearly similar in every respect, excepting their refrangibility and encroaching mutually on each other, was, perhaps, originally advanced by a Mr. Conisonni, the anonymous author of a work on colours, published at Piacenza in 1791, and noticed in the memoirs of the Academy of Berlin for 1792.

Mr. Prieur's experiments on the effects of the transmission of light taken from different parts of the spectrum through coloured substances, are little more than repetitions of those of Dr. Matthew Young, which are described in the seventh volume of the Irish Transactions, and thence in the fourth volume of Nicholson's Journal, in quarto.

These remarks will be sufficient to shew how far Mr. Prieur's theory can be supposed to have the merit of novelty: its antiquity is, however, not so great as to dispense us from the examination of the degree in which it may be intitled to the praise of truth and accuracy.

It appears, in the first place, to be somewhat difficult to reconcile the results of some of the author's own experiments with his theory: he seems to assert that there may be red and green rays possessing an equal degree of refrangibility, which, together, make a yellow that extends through a considerable part of the spectrum and at the same time, when the spectrum is as much simplified as

possible by refraction, he finds that the yellow almost entirely disappears. He says that he has found no bodies which transmit ultimately any other light than red, green, or violet; and yet he allows that a common prism, when sufficiently thick, transmitted only the straw-coloured rays; and after asserting that the parts of the spectrum are separated from each other by well-marked lines, he illustrates its composition by a diagram, in which each colour is imperceptibly shaded off into the next, and extends in some degree through the whole of the spectrum.

The grand question is however this; Have Mr. Prieur's experiments, together with Dr. Matthew Young's, fully established as a fact, that there are rays of different kinds which are not separable from each other by refraction, but which may be separated by means of the properties of coloured bodies? It must be confessed that the evidence appears at first sight to be strong, but it is not wholly unexceptionable; the absence of a visible coloured fringe from the blue spot viewed through a prism might arise from the weakness of that fringe when compared with the blue light itself; and the appearance of the faint green and violet would naturally be more observable when the blue light was intercepted by a coloured substance. The experiment on the yellow light also proves too much; for if the spectrum had been perfectly simplified, the yellow could not possibly have extended through the space of one seventh of an inch, which was the diameter of the pencil examined. And if the perfect accuracy of the experiments were allowed, it would still remain to be proved, that the light transmitted by the coloured bodies has not been modified in its passage through them, since the Newtonian arguments which shew the pre-existence of all colours in white light, would no longer be applicable to this particular case. The decisive experiment to determine this point would be to receive half of the blue pencil through a green, and half through a violet substance; to subject the pencil thus divided to a second refraction, and to observe if all its parts still continued to indicate an equal degree of refrangibility: and we have little doubt that the event of this experiment would be unfavourable to the opinion which Mr. Prieur has supported. Indeed, if this opinion were true, it might be established by a much more simple experiment than that which he has advanced; it would only be necessary to look through a prism partly covered with a coloured glass, at a narrow luminous object, and then, according to the colour of the glass, the violet rays ought to extend across the place of the blue as far as the beginning of the red of the perfect spectrum; and the green in the same manner as far as the beginning of the violet. But we will venture to affirm with confidence, founded in some measure on observation, that this would not happen, provided that sufficient care were taken to simplify the natural spectrum by employing a very narrow line of light, a good prism, and an eye well adjusted to the distance of the object.

Summary Considerations on the iridescent Colours of Bodies reduced into thin Pellicles; followed by an Explanation of the Colours of Tempered Steel, and those of Peacocks' Feathers. By C. A. Prieur.—*Ann. de Chim.* No. 182.

These considerations are so very "summary" and superficial, that they afford very little matter which can be thought worthy to be extracted. After mentioning the general phenomena of thin plates, as observed by Newton, he remarks that they have a very strong analogy to the colours produced by inflection, and in particular to those which appear upon viewing a luminous object through a feather, a piece of wire cloth, or of black crape, through a portion of stream, or a glass rendered opaque by breathing on it. He thinks the existence of the anguiform motion attributed by Newton to the particles of light may be fairly deduced from their passage, first through the sphere of repulsion and then through the sphere of attraction of every insulated portion of matter. This, he imagines, will probably afford an explanation of the fits of easy transmission and reflection, and of the colours of natural bodies. The colours of thin plates are distinguished, he observes, from the natural colours of bodies, first, by the division of the light in the one case into two portions, and in the other by the absorption of one of these portions; secondly, by the different assortment of coloured rays in the two kinds of colour, the violet of manganese, and the blue of cobalt and indigo, not being composed of the same kinds of light as any of the colours of thin plates, and a difference of thickness not producing a similar gradation of colours in each. In the third place, the one kind of colours becomes more brilliant, the other more diluted, by lessening the thickness of the substance; and the different colours seen in some infusions by reflection, are derived from particles of an opaque nature floating in the fluid: and, fourthly, the colours of thin plates may be varied by a change of the angle in which they are viewed, while nothing of this kind can be observed in natural colours.

The colours produced on the surfaces of metals, which are usually attributed to oxidation, Mr. Prieur chooses to consider as occasioned only by a separation of the superficial particles, in consequence of the action of heat: and he imagines the changes observable in the feathers of peacocks and pigeons are not derived from a cause similar to that of variations of the colours of thin plates, but from two or three different strata of colouring substances, the upper one being much interrupted, and the next semiopaque and capable of being rendered more transparent by moisture, which he says changes the appearance of these colours very considerably. A similar arrangement of colouring

substances, he also thinks the origin of the brilliant and beautifully versatile colours of the wings of some of the larger species of butterflies.

Observations. Although we cannot help suspecting that Mr. Prieur has borrowed some of his ideas from Mr. Jordan's remarks on colours, we do not think it necessary for the honour of this country to claim in this instance the merit of originality. There appears to us to be so little of importance in this paper, that it only deserves to be mentioned in order that some of its errors may be confuted.

The four distinctions between the colours of thin plates and those of natural bodies, which Newton compared with them, are all completely unfounded. In the first place, it is asserted that natural bodies do not reflect a light of that colour which is the complement to the transmitted light: now this cannot be proved by any experiment; for supposing each colouring particle of a red liquid to reflect a blue light, this light will be absorbed so completely in its passage through the surrounding parts of the liquid, that it can never reach the eye; and those few particles which are situated very near the surface afford too little light to be conspicuous; so that all such bodies, when viewed without the transmission of any light, appear completely black, as Kepler and Delaval have shewn. The second distinction is probably founded on inaccurate observations, for many coloured bodies produce combinations of light most strikingly analogous to the colours of thin plates; and if any others were found which differed from them, they might easily be supposed to be produced by a mixture of colouring particles of different dimensions. That a change of thickness of a coloured substance should produce a change similar to an increase of the thickness of a plate, is what on no theory could possibly be imagined; the increase of thickness of a coloured body must make the colour deeper, because it produces a more complete interception of the light which is to be absorbed; while the increase of the dimensions of a thin plate completely alters the nature of the colour reflected or transmitted; and in the fourth place, the change of colour occasioned by viewing a thin plate under a different angle depends on the refractive power of the substance, and is the greater as that power is less; being scarcely perceptible even in the case of the blue coat formed on steel; and there is no doubt but that upon the Newtonian hypothesis of the origin of the colours of natural bodies, the refractive density of the ultimate colouring particles must be much greater than that of any aggragates which we are capable of examining, since their dimensions must be extremely minute, and nothing but a very high refractive power could enable them to produce the colours of thin plates. Besides, since the general colour is supposed to be derived from the joint effect of a great number of particles in all possible positions, the same change of inclination that would render the red of one par-

ticle a little more crimson, would make that of another appear more orange, and thus the colour of the whole substance must consequently be independent of the direction in which it is viewed.

The only shadow of a reason that Mr. Prieur has for denying the oxidation universally supposed to be produced in tempering metals, is the circumstance of the appearance of the same colours on the surface of gold which had been heated. But he does not say that the gold was pure; on the contrary, it was a gold ring, and consequently was very considerably alloyed. The idea of a separation of the superficial particles, which he adopts, is too indistinct to bear examination.

There is nothing in the observations which Mr. Prieur has made on the colours of feathers that at all tends to weaken their analogy with those of thin plates. It is not with a single plate placed in the direction of the feather, that they are to be compared, but with a series of lamellæ, arranged as constituent parts of the feathers; and the colour of these may be modifyed by moisture, either as affecting their position, or their thickness. It is also possible that some of these colours may be derived from furrows or divisions of the surfaces, acting like the beginning of a thin plate of air, and that the contact of water might materially affect the colours by filling up these furrows. At any rate a good microscope would probably be a sufficient test of the fallacy of Mr. Prieur's hypothesis of two or three strata of coloured substances, the complication of which forms a strong contrast to the elegant simplicity of the Newtonian explanation.

New Optical Machine called the Phantasmascope. By Mr. Ez. Walker.—*Phil. Mag.* No. 106.

In this apparatus, a concave mirror 15 inches in diameter, is placed at the extremity of a box about three feet long; the other end of the box has at its upper part a circular hole, about half the diameter of the mirror, through which the image is reflected outwards; and from its lower half a sort of drawer, whose end next the mirror is taken off, moves forwards and backwards as required; at the farther extremity of this drawer a sliding piece is laid, that may be moved lengthwise in it by a strong wire passing through the front of the drawer; this sliding piece has an upright partition attached to it, that traverses the drawer, in which is a circular aperture about three inches in diameter, over which a painting of the image desired to be seen, done on glass or transparent paper, is placed; behind this partition two short candles are fixed, whose light is partly reflected by a screen placed a little way farther back, which prevents the image of the inside of the drawer from being thrown on the mirror. On the top of the drawer a tin co-

ver is fitted, to conceal the light; and a lid rises upwards from hinges in front of the top of the box, which both conceals the mirror and gives passage to the smoke of the candles. The image by this apparatus appears in the air about three or four feet before the front of the box; and, by drawing the slide forward by the wire, seems to retire to a distance, and is made to advance again by pushing the slide towards the mirror.

The effect of this method of throwing forward an image into the air, differs from that which is used in the exhibition of the phantasmagoria, by its producing the phantom in a room well illuminated, the light of which rather increases the perfection of its appearance, while the other can only be shewn to advantage in a dark apartment. The phantom appears considerably more beautiful than the image drawn on the glass; in painting which care must be taken that all the parts of the glass surrounding the image be rendered perfectly opaque.

Representations of the moon and the planets have a very fine effect in the phantasmascope; the images for them are made by punching holes through thick paper, stained very black, and pasting it over rough-ground glass.

A pleasing appearance is also caused by introducing a small painting or coloured print, instead of the painting on glass, and placing the candles on the other side between it and the mirror.

Observations.—The fact of the image appearing to stand out before a concave mirror, is a very old discovery. The learned Athanasius Kircher notices it in his Ars Magna Lucis et Umbræ, published in 1661, in the 10th book, chapter the 4th, 3d proposition, page 745, under the head of Magia Parastica. The title of the proposition relates immediately to this point, Idolum seu species objecti subinde extra speculum egreditur. Again, farther, in his Magia Catoptrica, page 779, he has an entire chapter on this phenomenon, with this title, De Egressu Idoli extra speculum sive de representatione rerum in aere extra speculum. A few years ago, this property of the concave mirror was exhibited here publicly by some foreigner, (whose name we do not now recollect,) as a show, with some other curious matters. In Ozanam's Recreations also, an apparatus is described for producing the same effect by a concave mirror which Mr. Walker's does; this apparatus was however fixed, whereas Mr. Walker's is moveable, and this is the chief difference between them. Mr. Walker's apparatus is however very convenient, and manageable, and may afford a pleasing addition to the means of affording innocent amusement to young people.

In vol. ii. page 144, of this work, we made some observations upon a paper of Mr. W. to these he affected to make a reply in a paper published in the Philo. Magazine, No. 101. The nature of this work will not allow us to enter into controversies, but we shall take the opportunity which this paper affords to offer a few

additional remarks on the paper in dispute, which we abstained from giving in tenderness to Mr. Walker's feelings; first observing, that Mr. W. is perfectly mistaken in attacking his old antagonist, Mr. Capel Lofft, as the supposed writer of the observations.

Mr. W. attempts, as he says, "to demonstrate" a certain property of the eye, in two ways. In the first, he makes a parade of algebraical substitutions, although there is no bringing of terms to an equation, no transposition, no extrication of known from unknown terms, yet after all he does not demonstrate the property of the plano-convex lens, but merely says in a note, "it is well-known to mathematicians."

The second demonstration is vague and loose in the extreme, and where he reasons from the assumed case of a plano-convex lens to that of the lenses of the eye, none of which are plano-convex, he evidently shifts his hypothesis before the conclusion is drawn.

We have already said, that Mr. W.'s pretended explanation is only an elucidation of that heretofore given by Berkeley, and we cited a passage from sect. 68. of that author's new theory of vision. Now although Mr. W. carefully avoids any allusion to what Dr. Berkeley has done, we desire our readers would compare Mr. Walker's "additional facts" in his last letter, with the 70th and 71st sect. of Berkeley, and they will at once perceive the source whence these facts were drawn.

Description of a New Boiler, constructed with a View to the saving of Fuel. By Count RUMFORD.—*Phil. Jour.* No. 71.

THIS boiler is in the shape of a drum, and consists of a copper cylinder, twelve inches in height, and as many in diameter, closed at the top and bottom with circular plates, from the bottom of which seven tubes descend, each nine inches long, and three inches across, closed at their lower extremities and open next the cylinder: from the top of the boiler a short tube arises, six inches in diameter and three inches high, shut at the top by a copper plate, through which three tubes pass, one of which is terminated by the safety valve, another conveys the steam where required, and the third conveys water from a reservoir to the boiler; this last tube descends to within one inch of the bottom plate of the boiler, and has a cock and floating ball attached to it, so placed as to keep the water always six inches high in the larger cavity of the boiler.

This boiler is placed in a furnace, three feet high, made of bricks, in the inside of an iron cylinder, seventeen inches in diameter, with a circular iron-grate of six inches diameter.

The object in view, in the construction of this boiler, was to give it such a form that the surface exposed to the fire should be

great in comparison with its diameter and capacity, and without having a great surface exposed to the cold air.

The Count states, that as the seven tubes which descend from the bottom of the boiler, are surrounded on all sides by the flame, the liquor is made to boil in a short time, and with a relatively less quantity of fuel, and therefore that this boiler may be employed with much advantage, in all cases where the production of steam is the chief object.

No particulars are given of any experiments performed to ascertain the effects of this boiler, in comparison with those of other shapes; but in order to form an estimate of the advantage which this boiler has over a boiler of the common construction, the Count compares the extent of surface that each presents to the action of the fire, by which it results that the advantage in favour of his construction is nearly as 17 to 12.

In large boilers of this construction, the Count mentions, that the seven descending tubes may be made of cast iron, and the rest of the boiler of sheet iron or copper; and he thinks it will cost less when constructed in this manner, than one of the usual form of equal surface. But he adds, in corroboration of former experiments, that in all cases where a great supply of steam is wanted, it will be best to use several boilers of a middling size, placed beside each other, and heated by separate fires, instead of one large boiler.

Observations.—A boiler of this kind must require much more workmanship in its construction, and of course be more expensive than one of the common form; its numerous tubes must be more liable to derangement and leakage, and much more difficult to repair.

This kind of boiler, likewise, cannot, with propriety, be said to be new; for a Mr. Cox Stevens obtained a patent in 1805, (of which we have given an account in our first volume, page 233,) for a boiler formed in a similar manner, by a number of tubes placed parallel to each other, and communicating with a flat vessel at their extremities. The number of tubes to be used, was not specified by Mr. Stevens, and the capacity of the vessel that received their ends was much less than that of this described; though this must occasion some difference of external appearance, the principles of both boilers is demonstrably the same.

Notice of an Experiment on the use of Steam in place of that of an open Fire, in the making of Soap. By Count RUMFORD.—*Phil. Jour.* No. 71.

THE steam, in this experiment, passed from a separate boiler, through a pipe, into the materials for the composition of the soap,

contained in a vessel of the usual form, occasioned a succession of smart shocks, similar to the blows of a hammer, which caused the whole apparatus to tremble: these shocks gradually subsided as the liquid became warm.

Count Rumford supposes, that the superiority that this method of heating the materials was found to have over the use of an open fire, was caused by the described motion; and, in order to prolong it, proposes, in a future experiment, to divide the vessel containing the materials into two parts, by an horizontal partition of thin copper, to cause a slow current of cold water to pass through the lower divisions, and to admit the steam into this lower part when the upper part becomes so hot that the percussions, caused in it by the condensation of the steam, cease. By these means, he thinks, the same motion will be caused in the cold water, and be communicated from it through the thin partition, to the hot liquid.—The Count states, that only six hours are required for making soap in this manner by the action of steam; but, in the common way, over a naked fire, sixty hours or more are required.

Observations.—The great saving, in time, gained by this method of heating the materials in making soap, must be a considerable advantage: it must also be very beneficial in the material object, of preventing all danger of burning the soap to the boiler, to which we apprehend the common method must be liable.

On the Stanhope Temperament of the Musical Scale; and, on different Temperaments of the Musical Scale. By Mr. John Farey. *Phil. Mag.* Nos. 107 and 108.

This author, having examined Lord Stanhope's temperament of the musical scale, and having in the course of this examination been under the necessity of making several calculations, and arrangements of the intervals which form the twelve sounds of an octave, has stated those calculations and arrangements in the first of the above-mentioned papers, with the intention of assisting other inquirers into the merits and defects of that temperament. In the first place Mr. F. observes, that in Lord Stanhope's monocord the length of the wire sounding C, is divided into 120 parts, and these are subdivided into decimals; whereas in the monocords that are commonly in use of the length of the wire which sounds C, or the key note, is made unity, or 1,0000, which is then divided decimally. Therefore, in order to render Lord Stanhope's temperament more intelligible to the generality of readers, Mr. F. has expressed Lord Stanhope's intervals, in numbers or divisions of the latter monocord, and these numbers, together with various other particulars, relating to the same temperament of the musical scale, he has stated in two tables, the contents of which are as follow:

Table I. *Shewing the relations which the several notes in an octave bear to the fundamental note C, when tuned according to the Stanhope temperament.*—This table is divided into 11 columns, the titles of which are, 1. Intervals in half-notes. 2. Letter or finger keys, 3. Diatonic ratios. 4. Diatonic marks. 5, 6, 7, and 8. Stanhope's intervals expressed in tuneable intervals, in ratios, in logarithms, and in length of string. 9, 10, and 11. Differences from diatonic in seven place logarithms, in ratios, and in parts of a comma.

Table II. *Shewing the relations of several notes or intervals in the Stanhope temperament, &c. to the key note C.*—This table is divided into eight columns, the titles of which are, 1. Numbers. 2. Names of intervals, references, &c. 3, 4, 5, and 6. Stanhope intervals, &c. expressed in tuneable intervals, in ratios, in logarithms, and in lengths of string. 7, and 8. Differences from diatonic in seven place logarithms, and in parts of a comma. It is evident, that in the various columns of these two tables, the intervals of an octave are expressed under different forms, and the nature of those expressions are sufficiently obvious, excepting, however, the 5th column of table I. and the 3d column of table II. which require some explanation, and which we shall give. In either of those columns different intervals are connected together by the signs of addition and subtraction, so that the aggregate of them all may produce an interval corresponding thereto in the preceding column. Thus, against the octave (or VIII.) in column 4th. of table I. we find in column 5. III. + 6th, V. + 4th, VI. + 3d, 4 + III. + 3. The meaning of which is, that if you take a third major to the key note, and a minor sixth to this third major, this minor sixth will be the octave to the key note. For instance, let C be the key note, its third major is E, and a sixth minor to E is *c*, viz. the octave to the key note; or the octave consists of a fifth and a minor fourth; or it consists of a sixth major and a minor third; or lastly, of a minor fourth, a major third, and a minor third; the major term being expressed by roman, and minor by arabic figures. Expressions similar to these are annexed to the other notes of the octave in the above-mentioned columns. Immediately after the above-mentioned tables, this author states the manner of adding and subtracting ratios, which though well-known to mathematicians, may not be generally known to musicians; and to this he subjoins a short illustration of the nature of logarithms, which are rendered highly useful in the doctrine of musical sounds, by their peculiar property of numerically or lineally measuring ratios. He then makes various remarks on Lord Stanhope's essay respecting the musical temperament, which are not susceptible of an intelligible abridgement; and after these he says, "On the whole I would not be considered as now giving "an opinion on the merits of the Stanhope temperament compared "with those of Mr. Kirnberger, Dr. Young, Mr Hawkes, &c. &c.

"but rather as anxious to assist the enquiries of those who, posses-
"sing more leisure than my professional duties at present leave me,
"may be disposed to examine it thoroughly in all its bearings."

In his second paper, Mr. F. expresses a wish that the true principles of a musical temperament may be investigated and defined by persons skilled in music as well as in the mathematics. For this purpose, he thinks that before we can reason as to the propriety of the proper temperament, it will be necessary to determine the exact number of fixed sounds, which are meant to be introduced in an octave; and if more than twelve such sounds should be found expedient to be introduced, then the consequence will be, that either musicians must learn to perform on a greater number of finger-keys, strings of harp, &c. or moveable stops must be adapted to musical instruments, after the manner indicated by Dr. Smith and Mr. Maxwell.

Mr. F. also observes, that in any temperament where the imperfections are to be thrown on some particular keys more than others, it must be previously inquired, not only how frequently each key is likely to occur, and how long to be used, in proportion to the use of other keys, "but we are also required to take into consi-
"deration the frequency with which chords, between almost
"every two of the notes in the septave (of which each key must
"consist) are likely to occur."

Observations.—We have endeavoured, as concisely as possible, to give the most prominent particulars of Mr. Farey's two papers; and considering the variety of calculations, comparisons, and observations, he must have made in the course of this investigation, we cannot but admire his perseverance. We are however of opinion, that the nature and limits of a musical temperament may be comprized into a narrower compass than Mr. F. seems disposed to admit. In the seventh number of the Retrospect, we advanced our remarks on the nature of musical temperaments, principally relating to Lord Stanhope's method, and upon further consideration, we find no reason to alter our opinion; excepting perhaps, that we did not sufficiently qualify our expressions when we recommended the isotonic or equal temperament. We still maintain, that where an instrument is subject to be played on, in almost all keys, as in concerts, and by the first-rate performers, and as, in fact, an instrument, if it approach perfection in its temperament, must be, there is no method so good as the equal temperament, because if some keys are made better than that method gives, others must of necessity be worse. But we are willing to concede, that when an organ or piano forte is to be used in only a few keys, these particular keys should be tuned as nearly perfect as possible, at the expense of all the others. In doing this, some performers would prefer the Stanhope temperament, as making their favourite keys approach nearer to perfection than

any other mode. To others this temperament would be absolutely intolerable, because most of the keys they delight to play in, are therein very far from perfect. It should therefore be the first business of a tuner, to enquire the intended uses of the instrument he is about to tune, and temper it accordingly. Whence if the instrument is to be unrestricted in its uses, the temperament must be isotonic, as before observed.

It is acknowledged on all hands, that all octaves of piano fortes and other instruments with fixed tones, must be tuned perfect, the human ear not suffering any deviation from perfection in those concords.

Since each of the notes of a musical octave, may be considered as, or taken for a key note, there must be some other note of that or of the following octave, which is a fifth to it; and if the whole arrangement of musical sounds be examined, it will easily appear, that each note is a fifth of some other note, or an octave to it; therefore in tuning or in tempering the musical scale, it will be sufficient to consider all the notes as fifths one to the other; thus G is a fifth to C, D is fifth to G, A a fifth to D, E a fifth to A, and so forth, until the 12th-fifth, which is C, and which of course must coincide with the seventh octave; hence, an octave is divided into 12 sounds. For though the same notes are thirds and sixths to other notes in tuning or in tempering; a strict attention must be paid to the effect they produce as fifths, because the human ear will suffer the fifth to deviate from perfection less than it will the thirds or sixths.

The last of the twelve successive fifths, is higher than the seventh successive octave. Therefore in order to make them coincide, it becomes necessary to flatten the fifths. Now if the fifths be flattened equally, the result will be a temperament in which the greatest deviation from the diatonics, is only a *thirteenth* of a tone, and this falling in the minor thirds and major sixths; while the deviations in the fifths are only an *hundredth* of a tone; an imperceptible variation from the true chord. And none of the deviations, in fact, amounting to so much as is commonly occasioned in a few days, by the thermometric or hygrometric changes in the atmosphere.

With respect to the determination of those keys, which ought to be rendered more perfect than others, admitting that the instrument used is to be restricted in its uses, it is impossible to assign their names and number, because every musical composer may wish to prefer any of them to the rest. The temperament which is at present, generally used in England, undoubtedly is not a very determinate one, since the tuners of organs, pianofortes, &c. generally judging by their hearing, cannot possibly be very accurate, nor can they agree exactly with one another; yet they all agree in rendering the keys C, D, E, flat, B, flat, F, and a few others, more perfect, without rendering the other keys absolutely insufferable. And this temperament or manner of tuning,

may probably be the best, so long as we attend to the consideration that a vast deal of excellent music has been written for the express purpose of producing particular effects with such temperament; nor could the effect intended by the composer be preserved, if the temperament of musical instruments were materially altered —let, for instance, a favourite piece of music written in the key of B flat, be transposed by a skilful performer to the key of E natural, and a discriminating ear will find the effect utterly destroyed by the transposition.

The increased number of finger keys adverted to by Mr. Farey, was formerly introduced upon several organs and harpsichords. There generally were two sets of black, or short keys, one of which served for what are called flat, and the other for sharp, notes; but the effect of the performance was found inadequate to the difficulty of performing on such instruments.

Observations on Atmospheric Phœnomena, and particularly on the Formation of Clouds. By Mr. Cornelius Varley.—*Phil. Mag. No.* 106.

When a thunder storm is gathering, small specks of clouds are observed to unite, until a large cloud highly charged with electricity is formed, which giving a spark to the earth, occasions a heavy torrent of rain, other clouds join the large cloud, another spark is taken, succeeded by more rain.

In fine weather, the clouds brought from a distance by an easterly wind, break up, and are dissolved in the air, without any rain falling. This solution of cloud in the air is promoted by their striking against mountains. After a continuation of this fine weather, the sky is very pale and misty, hence the air does not hold the water of the dissipated clouds, or the vapours raised by heat in solution; but when the clouds appear again, the sky becomes bright, and distant objects more distinct. During the continuation of this fine weather, it is observable, that no dew falls the first evening, but it increases every successive evening, until it obscures the ground as soon as the sun is set, and the following mornings are very foggy. It appears, therefore, that the sun raises more vapour than the electricity present could support in the night, in consequence of the electricity having been drawn off to form clouds during the preceding fine weather; so that the vapour raised in the day falls down at night,

Therefore, we may infer, that electricity is the suspending power in clouds, and that dry air is a conductor of heat, but a non-conductor of electricity. According to Mr. V. there are five states of water, of which four are permanent, and one temporary, viz. ice; water; vapour, which is the temporary state; the first electrical state or that of cloud; the second electrical state, which is a complete saturation of water with the electric fluid,

and thus a compound is formed that is transparent, and so light as to float above the highest clouds.

When the sun raises vapour, and there is no electricity in it, the water as soon as the sun sets begins to fall down as dew; if there is a little electricity present, it falls slowly in the form of fog; if there is more, it remains suspended in the air; a greater quantity of electicity carries it up in the atmosphere, and it forms compact clouds; a still greater charge of electricity dissolves it, and forms an aqueous atmosphere, which occupies the highest regions above the clouds.

In fine weather, the electric state of the earth being the same with that of the air, they are repelling each other; and the temporary action of the sun increases the quantity of the clouds and watery part of the atmosphere. Hence the atmosphere must get higher at that place, or else denser; in either case the barometer must rise; and when it rises rapidly, we may infer that the evaporation by means of electricity is going on very fast. When no discharge of this accumulated electricity is effected by the fall of rain, the accumulated electricity will become so strong, that an effort of nature to restore the equilibrium will of course follow.

When a change in the wind brings vapour without electricity, the air will become damp enough to form a slow conductor, then the clouds, robbed of a portion of their electricity, will condense, the barometer will sink, and stormy weather follow.

That electricity is the suspending power of clouds, is also evident from the permanency of clouds in such cold regions that dew would be immediately frozen, and descend in the form of snow. Hence clouds may be denominated *electrified vapour*, and the exhalations that form dew, *calorified vapour*. When a cloud loses its electricity in an atmosphere below the freezing point, snow will be produced; but if rain already formed passes through a cold region, it will come down in the shape of hail. The influence of electricity in producing rain, is also pointed out by rain being more abundant and frequent in mountainous countries than in flat ones.

Improvement in the Stands used by Painters and Glaziers when working on the outside of Windows. By Mr. Joseph Davis.—*Trans. Soc. Arts*, vol. xxiv.

Mr. Davis's improvement of the glazier's stand is intended to afford a better mode of securing it to the window than that supplied by the long moveable pins or bolts in common use, whose inadequacy in this respect has been the occasion of many fatal accidents; instead of these bolts, Mr. Davis uses a sort of sliding bracket, that is moved forwards or backwards along the plank of the stand underneath, as required, by a long screw which passes through a nut in the bracket, and turned by a winch at the inner end of the stand, where it passes through a collar: the foot,

or outside support of the stand is formed in the common mode; when the stand is placed at a window, the window seat, or the sill, is griped between the outside foot and the bracket, as if it were in a vice, by turning the screw to the necessary degree.

The bracket slides along steadily under the plank by two dovetailed grooves in the latter, in which corresponding parts of the bracket are inserted dovetails to fit the grooves easily.

A bar of wood accompanies the stand, to place inside across the window, against which the bracket is to be screwed, when any injury might arise from screwing it against the centre of the recess of the window.

Observations.—It would render this stand more secure if a light rail were fastened to its outside extremity, to prevent the danger of falling backwards to the person using it; the rail might be made moveable, so as to be taken off occasionally for the convenience of carriage.

This stand is certainly very superior to that in common use. If master glaziers have not their stands constructed in this manner in future, the accidents that must happen from the use of the old implement may with justice be attributed to a very culpable negligence.

It would afford still more security in cleaning windows than what can be given by this stand, or any other of even more perfect structure, to have the slips of the sashes constructed so that they might be removed and fixed up again firmly in their places, with a facility which would permit the sashes to be taken down into the apartment, and cleaned by a servant with as much ease as the French folding sashes are now. For this purpose, only half of each slip at one side of the window need be made moveable, the rest might remain fixed as at present; the moveable half of the slip might be joined to the fixed half by a hinge, or a catch joint, and be secured to the window-frame by a small sliding bolt at the other extremity.

As some persons may prefer folding sashes to moveable slips, it may not be amiss to mention here, that a method has been contrived by Mr. Collinge, for preventing the great defect to which they are liable of having wet forced through their joints by the wind, and which has been described in our last number.

Account of a Paper of Dr. William Roxburgh's, *containing Observations on the comparative Strength of Hemp, and of various East Indian vegetable Fibres used for and applicable to the same Purpose.—Trans. Soc. Arts,* vol. xxiv.

To prove the durability of various vegetable fibres, Dr. Roxburgh macerated them in fresh water, during the hot season in Bengal, from the 27th February to the 22d of June, 1801, hav-

ing previously tarred and tanned specimens of each species. In this manner he prepared

1. English hemp,
2. Indian hemp,
3. Coir,
4. Ejoo,
5. Robinia Cannabina, cut when ripe,
6. Robinia Cannabina, cut in blossom,
7. Crotallaria juncea,
8. Corchorus Clitorius,
9. Corchorus capsularis,
10. Indian flax,
11. Agave Americana,
12. Aletris nervosus,
13. Theobroma Augusta,
14. Thobroma guazuma,
15. Hibiscus tiliaceus,
16. Hibiscus Manihot,
17. Hibiscus mutabilis,
18. Hibiscus, from Cape of Good Hope,
19. 20. Bauhina, in different states,
21. Sterculla villosa.

The Ejoo proved the strongest of those immersed in the white state; the Robinia cut in blossom, of those that were tanned, and also maintained an equality in the tarred state with the Crotallaria juncea, which was stronger than any of the others so prepared.

Nos. 7, 8, 9, 13, and 14, retained their strength surprizingly; No. 15, (the bark with which the inhabitants of the South Sea islands make lines) gained considerably in power in its tarred state; and tar in general appeared to be a better preservative than tan in this experiment, though the contrary is mostly supposed to be the case. The fibres of the East Indian plants stood the test much better than hemp from England, or that of Bengal.

Dr. Roxburgh tried the fibres of many other species, besides those which yielded hemp or flax, several of which appeared to be before unknown, though most were long in use in Asia.

The experiments were made on cords four feet long, formed of three single yarns of fibres from the following substances :

1. Hemp of Calcutta,
2. Jeetee of the Rajemahl mountaineers,
3. Shrubby kind of Urtica,
4. 5, 6, 7, 8, 9, 10, Sun Crotalaria juncea, in different states,
11. Corchorus capsularis,
12. The same from China,
13. Corchorus olitorius,
14. Robinia Cannabina,
15. 16, Abroma Augusta, in different states,
17. 18, Hibiscus strictus, in different states,
19. 20, 21, Hibiscus cannabinus, in different states,
22. Hibiscus sabdariffa,
23. Hibiscus Abelmoschus,
24. Hibiscus esculentus,
25. Hibiscus bifurcatus,
26. Hibiscus pilosus,
27. Theobroma guazuma,
28. Musa Suberba, a species of plantain.

Of these the cord made from the Jeetee supported 248lb. when dry, and 343 when wet, before it broke; the shrubby Urtica was the next in strength, and the Sun bore the third rank, some of which supported 160lb. dry, and 209lb. wet.

Of the Jeetee the Rajemahl people make their bow strings, which are said to last five years exposed to the weather. It is the bark of a twining shrubby plant, a new species of Asclepias.

The shrubby Urtica is called Calooee, or Poolay by the Malays, and its fibres are very fine and beautiful as well as very strong.

The Hibiscus cannabinus is an annual universally known in India; it is cultivated both for the fibres of its bark, and for its green leaves, that have an agreeable acid flavour like sorrel, and which the Hindoos use as a pot-herb. Ejoo, No. 4, of the former experiments, is the Palma Indica Venifera; it grows well in Bengal; and this palm abounds, probably more than any other, in liquor producing wine, sugar, and spirits, and its pith is one of the varieties of sago. A description of this tree has been lately published by Labillardie under the name of *Arenga Sacchefera.* It is called Anou by Marsden in his history of Sumatra. and *Borasus Gomutus* by Louviero in his Flora Cochinchinensis. Dr. Roxburgh highly recommends this tree for cultivation in the West-Indies. He has sent specimens of its fibres to the repository of the Society of Arts, along with some of a light aquatic plant used as floats for nets, and a variety of other purposes by the Hindoos.

Two tables, stating the exact weights with which the fibres of each of the vegetable substances mentioned, broke in different states, and relating other particulars of them, accompany this communication.

Remarks are also added on most of these plants, from which those that appeared most interesting have been related.

Dr. Roxburgh has added at the end of his observations on vegetable pines, a table of the growth of trees in the botanic garden at Calcutta: from which it appears that several valuable species of foreign timber trees succeed extremely well in Bengal, and are likely to be valuable acquisitions to that country, particularly the Mahogany tree, of which 500 plants had been reared in 1804, from two plants sent out in 1795, by the India Company. The Nutmeg tree also promised to thrive well there.

The thanks of the Society of Arts were voted to Dr. Roxburgh, for his communications on the foregoing subjects.

Observations.—The importance of Dr. Roxburgh's experiments will be better understood, when it is known that hemp is so scarce in India, that it is necessary in general to send out cordage for the supply of the Navy in that part of the world, as well as for the Indiamen, at the very heavy expense which the transport of so bulky an article must occasion in such a long voyage.

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RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL AND AGRICULTURAL

DISCOVERIES.

No. X.] *July, August, September.* [1807.

AGRICULTURE.

Observations on the Cultivation of Lucern. By Mr. G. LINDLEY, *of Catton, near Norwich.—Annals of Agriculture,* No. 264.

THIS correspondent occupies a nursery, and raises lucern seed for sale; and having observed that many of his friends had lost their crops of lucern, either wholly or in part, he communicated some observations on the subject, which he had deduced from experience, to the editor of the Annals, for publication. After a few preliminary observations on the value of lucern in general, and particularly as a substitute for clover, he notices the two chief objections to its more extended culture;—the liability of its being destroyed by the fly, if sown alone; and the chance of its being smothered by a crop of grain, if sown in conjunction with one: and though he does not consider it prudent to insist on one method as being the best, or on another as being the worst for sowing the seed, as this might only produce controversy, yet he offers such suggestions as have struck upon his mind to be effectual for the preservation of the crop. It is remarked, that whether the drill or the broad-cast system be adopted, either with or without an upper crop, in both instances the crop frequently miscarries: in the former case, the corn crop is frequently so heavy, that the plants are from weakness unable to withstand the severity of the following winter; and in the latter case, they seldom escape the ravages of the fly, which has caused such devastation in the county of Norfolk, as to deter many farmers from attempting the cultivation of the plant. He therefore considers the depredation of the fly to be the first thing guarded against; and as these attacks

are only to be apprehended during the time the plants are in their seed-leaves, recommends means similar to those resorted to for the preservation of the Swedish turnip. To preserve the turnip, four pounds of salmon radish to the acre have been sown with the desired success; but he considers that a much larger quantity of radish would be required to afford equal protection to lucern, because the plants of lucern in their first stage are much smaller than those of the Swedish turnip, and on this account radish-seed migh be deemed too expensive: he therefore proposes buck-wheat to be substituted, and that in such a quantity as will produce plants sufficient to cover the ground, when they are six or eight inches high. These he conceives to encourage the young and delicate plants of the lucern, and as they advance in height, to afford protection to, and screen them by their shade from, the effects of extreme drought or heavy rain, as well as preserve them from the fly. As soon as the lucern is sufficiently high to stand against the scythe, he advises that the whole should be mown off, though the crop in this state be only fit for manure; for the buck-wheat will not grow again after its crown is cut off, for it is an annual plant, and the first mowing completely destroys it. The lucern afterwards has the advantage of entire liberty and free air, has shed its seed-leaves, which only are attacked by the fly, and shoots forth in luxurious abundance, without danger of casual injuries. The plan of sowing lucern very late in the summer, which some adopt to escape the fly, he considers by no means deserving of imitation; for in this instance it may so happen, that the young crop should neither be strong enough, nor sufficiently well established in the ground, to resist the attacks of the following winter, particularly if there be much wet and frost in the succeeding autumn; for this plant, if weak and late sown, is not only liable to be injured by cold, but from having no collateral roots, may be much loosened in the ground by the action of frost. From the same reasoning, which he states to have been confirmed by experience, he argues against the transplanting of lucern in the autumn; an idea recommended by speculative theorists: he asserts, that whoever will make the experiment, will find his plants so much raised previous to the spring, as scarcely to have hold of the ground; and expresses his decided disapprobation of the practice.

He is induced both by reflection and experience, to recommend the simple method of sowing lucern broad-cast, about the middle or latter end of April, twenty pounds of good seed to the acre, without an upper crop or any other seeds whatever, except radish or buck-wheat; of the former it will require six or eight pounds to an acre, but of the latter half-a-bushel will be sufficient. If the land be prepared as for barley, or if turnips have preceded, and the ground be clean and in good condition, he apprehends that every thing which can be expected from lucern will be obtained, and that without risk or disappointment.

Observations.—Experience having shown that clover cannot be very frequently repeated on the same land with any prospect of tolerable success, it is of much importance to those who rely on crops of artificial grasses for the support of their stock, that another kind of crop of a similar nature should be introduced, to which recourse may be had when there are doubts of the success of clover. No other kind of artificial grass appears so well calculated to afford this succedaneum as lucern; and consequently, whatever can tend to ensure the preservation of a crop, will be favourably received by the intelligent farmer. The observations of Mr. Lindley are certainly deserving of notice, and where a crop of lucern is the *only* object in view, his recommendations may be followed with advantage. But at the same time it must be remembered, that the plan here laid down can only be followed at the expense of losing a crop of spring corn, (barley or oats) which in few districts cannot be worth less than five pounds per acre, and frequently much more; and therefore it becomes a question of comparative utility, whether it be advisable to *ensure* a crop of lucern at this expense, or to *take the risk* of obtaining a crop, if sown with spring corn. The difference of expense must be too trivial to form a part of the consideration; for the buck-wheat, together with the mowing and carting-off, cannot cost much less than the seed corn which would have been sown; and the cost of preparing the land will be the same in each case. These considerations may not have occurred to Mr. Lindley, as a nurseryman, having nothing to do with corn, but they are too obvious to be overlooked by the practical farmer; and it is probable that very few men of this class will be found, who will sacrifice a crop of corn for a crop of lucern, and especially when it is *probable* they may obtain both.

Report of the Workington Agricultural Society for 1806. *By* John Christian Curwen, *Esq. M. P.—Ann. of Agr.* No. 264.

This member of the British senate not only presides over the Agricultural Society, which takes its name from his seat in Cumberland, but has set apart a farm, called the Schoose, in that neighbourhood, for the purpose of practically demonstrating to the farmers on the moors the advantages and benefits of good husbandry. The first part of the Report is merely an account of the distribution of premiums, and consequently only locally interesting; but his own Experimental Agriculture is deserving of more general consideration; for he not only states the experiments which were made at his farm of the Schoose, but endeavours to explain the principles they were intended to elucidate. His first

object was, to free the ground from every unproductive plant; the second, to bring the ground into garden culture; and, in order to obtain the whole nourishment it is capable of yielding, by repeated ploughings during the whole summer, to admit the air and moisture to penetrate freely to the roots of the plants, conceiving that, by this means, all the advantages that manure can produce may be obtained; and he asserts, that a small proportion of manure, with constant workings, will undoubtedly yield better crops than can be had by any quantity of manure without it. He is of opinion that five feet stitches, with the superior advantages of tillage, will yield per acre as much as those on three feet stitches. He comments on the saving of food made by soiling and stall-feeding cattle, and asks, whether one acre thus employed is not equal to seven grazed? contending, that the expense of cutting and carting is more than repaid by the manure that is gained: clover he considers, under this management, to be productive above all other crops. He relates an experiment on the culture of carrots, and states the produce to be thirteen tons and an half per acre: carrots he thinks to be very little, if at all, inferior to oats in the feeding of horses, and by experience pronounces them to answer admirably as a part substitute for oats, having given his horses five pounds of carrots per day in lieu of four pounds of oats, and finding them improve in condition upon this feeding. His experiment on cabbages produced 2352 per acre, weighing 116 stone 12 lbs. or 35 tons and a half per acre, which, at 1½d. per stone, amounts to 35l. 10s. per acre. As this crop had excited much attention in the immediate neighbourhood, he states the method he pursued in obtaining it.—The trenches were first drawn by a single plough, then followed by a double mould-board plough with four horses, in order to bury the manure as deep as possible; each plant had four feet and a half square; about a stone of manure, of an indifferent quality, was allowed to each cabbage; they were set with a line, to secure their being perfectly exact, so as to permit the ploughs to work in every direction; they were planted the first week in April, but being put in with too thick a dibble, many died in consequence; the ploughs were kept at work, in various directions, during the whole summer, which contributed greatly in producing so remarkable a crop, which would have been much larger had the plants generally succeeded. He observes, that the value of green crops may appear surprising to many; but he intreats that those who may be least disposed to agree with him in opinion, will be at the trouble, before they reject it, of making their own calculations. He admits the expense of this system to be undoubtedly great, but adds, so is the produce. He remarks, that the error most farmers fall into is, endeavouring to do too much; and ventures to assert, that a little well done will make most ample returns; "It is better," says he, "to leave half the

farm in a state of nature, and completely cultivate the other half, though rent be paid for the whole;" and subjoins, "if I am right, it points out the folly of having too large farms."

He then gives a particular account of the whole of the Schoose farm, the number of acres under each crop, the quantity and value of the respective produce, and observes, it will be found from the detail, that 306 acres of well cultivated land have produced 3880l. or nearly 13l. per acre, while 170 acres of pasture land have produced only 755l. or about 4l. per acre. The expenses attending the system here followed are admitted to be very considerable, but the profits are represented to be such as amply to compensate them: in the estimate of the crops, the advantage gained on the consumption of them by the farmer is not included, though it is very great, especially where many horses are employed. He concludes by observing, that he has been led into this digression solely with a view of showing what very moderate ground will produce, and to draw the attention of the society to the progressive improvement yet to be made: he apologizes for the length of the detail into which he has been led, and hopes the ensuing year will afford him the pleasure of submitting further improvements to their consideration.

Observations.—This very sensible and very well written Report deserves to rank high among agricultural productions: the learned chairman of the Workington Society displays as much patriotism as agricultural knowledge in his farming at the Schoose, which is evidently conducted not so much with a view to private emolument as to public utility; and we trust that the instructions to be reaped from his system of husbandry will not be confined to the moors of Cumberland, but be diffused throughout the British Islands. Mr. Curwen may safely be exhibited as a model of an independent country gentleman, cultivating and improving an inhospitable tract of country, to afford an example to his neighbours and constituents, pointing out the attainment of wealth through the path of industry, and being at once the friend and the father of his surrounding tenantry. His experiments are conducted with the nicest accuracy, and at the same time with the greatest simplicity; thereby convincing the understanding without bewildering the judgment. His candour in explaining every thing can only be equalled by the energy with which his husbandry is conducted. As a farmer he has obtained the thanks of his neighbourhood, and deserves the gratitude of his country.

Receipt for destroying Insects.—Annals of Agriculture, No. 264.

This Receipt for the destruction of Insects in the ground, is particularly recommended to be applied to turnips, when coming up; for if they are then watered with this liquor, it is stated that

no insect will touch them. The liquor is made by steeping the green walnut peeling, when the nut is ripe, about twenty-four hours, when the water will be completely impregnated by the walnut peeling, as to be rendered certainly destructive to all insects.

Observations.—This simple and unexpensive preparation, may be easily applied in gardens, but can never be extended to the field culture of turnips, because, as the turnips are sown at least two months before the preparation can be made from walnuts of the same year, it is necessary to provide the year preceding, and keep it in vessels till wanted.

On Farm Offices. By J. F. E.—*Farmer's Magazine*, No. 31.

This communication, which is accompanied with a plate, and has many quotations from Marshall's Rural Economy of Glocestershire, contains also many useful observations on the construction of farm offices. It is recommended that each team of cart-horses employed on a farm, should be kept in a separate stable, instead of two or three teams being brought into the same, by which an infectious disorder may frequently be prevented from spreading entirely through the horses on a farm, and besides, the collecting many servants in one stable often occasions much neglect, and affords temptations to idleness: the writer also thinks it would be more economical, on the ground of preventing waste, to have the racks placed upright instead of sloping, as many horses have a bad habit of pulling out their fodder, and letting it fall beneath their feet: the pavement of the stalls, he conceives, should be as level as possible, for nothing can be worse for a horse's heels than to make him stand always on a slope or declivity, which not only occasions grease, cracks, &c. but by keeping the tendons and sinews of his pastern joints in a constant state of extension, causes a stiffness in those joints, which must prevent the free use of them: he therefore recommends that a small drain should be made in the middle of the stall, towards which all the extreme parts should decline about an inch, and that this drain should be covered with an oak plank, bored full of holes, and the drain itself to slope considerably outwards towards the main drain of the stable, into which it would carry all the moisture: this drain he admits having copied from a description of a Mr. Beatson in a communication to the Board of Agriculture on that subject. With respect to the hanging of doors for farm offices, he advises, that instead of hinges, the doors should be hung on a pivot, placed a few inches from the post, and fixed to the outside of the door, or in the floor at that point, and covered by an eye fixed on the outside of the door;

by which contrivance the doors would go quite back to the wall, without receiving any injury. He also recommends tiling upon straw or reed, instead of laying the tiles on the naked rafters, by which means the buildings would be kept more warm in winter, and more cool in summer, and the tiling be less liable to be displaced by storms.

Observations.—This paper certainly contains some useful observations on the construction of farm buildings; but they are mostly borrowed from preceding publications, and have nothing else to recommend them, but being brought together into one point of view from various different sources.

On feeding Cows with Hay, and Oat-Straw. By Novice Junior.—Farmers Magazine, No. 31.

This writer having often heard it remarked, that hay afforded nourishment superior to straw of any kind, when used as food for black cattle or horses, devised an experiment for ascertaining this fact. *In January* 1795, he began to give a milch-cow as much newly thrashed oat-straw, of the preceding crop, as she chose to eat, with half a peck of potatoes each day, and measured the quantity of milk drawn from her each day for a week; at the expiration of which period, she began to receive in lieu of the oat-straw, for the succeeding week, as much good hay, composed mostly of rye-grass and red clover unthrashed, also of the last year's crop, as she could eat, besides the same measure of potatoes as formerly: on comparing the quantity of milk afforded from these different sorts of food, he found them exactly the same.

Observations.—If this young novice discovered *twelve years ago*, that oat-straw given to milking cows, would produce as great a *quantity* of milk, as good hay; he must have become an old novice, for not having ascertained before this time, whether as much *butter* would be produced in the former case, as in the latter. He does not seem to have been aware, that the value of milk produced by any given food, is not to be determined by the *quantity* only, without ascertaining the *quality*.

Some Hints on different Sorts of Cows.—Agricultural Magazine, Second Series, No. 12.

In this communication it is remarked, that the *North Wales cow* is best adapted for the stock of a farm, when the land is poor, and affords but little good feed, and that the *South Wales cow* will give a tolerable supply of milk on middling land, and a great supply where the land is rich. The *Alderney cow* is said

to have acquired much reputation for giving fine rich milk, but less in quantity than many other kinds, and this kind, as well as the *Devonshire,* which is very handsome and much larger, are reckoned to produce the most excellent butter, even on middling feed, but the Devonshire bears the winter best, and is on that account most profitable for the dairy. The *North Wiltshire cow* is stated to be well suited to rich lands, on which it yields a large quantity of sweet milk, which makes cheese and butter of the first quality: and these latter fatten well, after they have done milking. The *Yorkshire cow* can only be kept on land that is good and fertile: their milk is great in quantity, but not rich in quality: they also require high keep to fatten them in the stall. The *Herefordshire cow* is also held to be profitable only on land which is rich, and has abundance of wholesome herbage; they, however, fatten better than the Yorkshire, and being large in size, and handsome in shape, come to a good weight, when ready for the butcher,

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Observations.—This anonymous article on the different breeds of cows contains only those facts which are universally known, and universally assented to by dairy farms. The observations are worthy of recollection, only for the truths which they recapitulate, but have no pretensions to information or novelty.

On the Culture of Potatoes. By a Farmer.—Agricultural Magazine, Second Series, No. 12.

In this paper, a method of planting potatoes is pointed out, which is said to be effectual for preserving them from the frost. This farmer recommends, that previous to ploughing the land the last time, manure should be put on, and well harrowed in: then a plough drawn by one horse, is to be had recourse to, to turn the earth on each side at one time, which will produce a furrow six inches in width: a man should then follow the plough with a tread, who should make his holes about three inches apart, into which the potatoes should be dropped, and covered up: the distance between the rows should be about thirteen or fourteen inches. It is asserted, that by planting them in this manner at the bottom of the furrow, they would be secured from the frost; and grow in the same manner as celery does in garden culture, and that there will be plenty of earth to cover the roots at the future hoeings, which is a great advantage to this kind of crop, but an advantage seldom obtained in the usual mode of planting them in the fields. The produce from this mode of culture, is said to be seldom less, on good land, than 960 bushels per acre; a more than adequate return for the additional expense.

Observations.—This communication, which is the last paper of the *last* number of the Agricultural Magazine in its old shape, that

we can submit to the readers of the Retrospect (the rest being all copied from the published agricultural surveys) offers some sensible observations on an important subject. That the goodness of the potatoe depends altogether on its being completely covered with mould, is too obvious to need explanation; and whatever renders this certain and indubitable, deserves the attention of the agriculturist, and the gardener, who raise this valuable root on an extensive scale.

Some Observations on Turnip Drills, and a new one described. By R. W. Dickson, M. D.—*Dickson's Agri. Mag.* No. 1.

It is observed that the broad-cast system of cultivating turnips, most generally prevails in the Northern parts of the kingdom, while in the South, the drill husbandry is principally practised. He thinks the preference to be given to the one or the other of these systems, ought, in a great measure, to be determined by the nature of the soil, as in the more stiff and retentive sorts of land, the drill system may have the advantage; but in the light, sandy, gravelly, and porous descriptions of ground, the broad-cast may possess a superiority, in more effectually preserving the necessary moisture, for the perfect growth of the plants. Some remarks follow on the horse and hand drills, the difference between which is stated chiefly to consist in this, that the former is capable of sowing many rows at the same time, while the latter sows one only. The writer then describes an improved horse drill, which has been found to answer perfectly in Berwickshire. This implement being formed of a roller, placed before the delivering tubes of the drill itself, which roller is reduced to a smaller diameter, immediately before those tubes, than in the other parts, flattens several ridges or drills, puts in the seed and covers it at the same time, by the pressure of the larger diameter of the roller forcing the mould sideways over the seed, which has been deposited by the tubes of the drill, and a smaller roller is annexed by chains to follow; by which means the necessity of having recourse to other tools is avoided, and consequently time and labour saved in performing the operation. The name of the maker of this drill, and the price he charges for it, are annexed to the account; and it is added, that it is used by the Earl of Mansfield at his farm near Hampstead.

Observations.—The doctrine laid down in this paper, by the new Editor of the new Agricultural Magazine, respecting the unfitness of light, sandy, and gravelly land, for the drill husbandry in the cultivation of turnips, is in direct variance with the practice of the most skilful agriculturists in England. In the counties of Suffolk and Norfolk, where the drill is most universally introduced, the greater part of the turnip land is of this description; and if

the peculiar excellence of the drill husbandry is superseding the necessity of fallow, from the greater facility afforded for destroying weeds by this mode of cultivation, it must be very desirable on heavy wet lands, where fallows cannot frequently afford sufficient means for the destruction of noxious herbs, without much assistance from other advantages. So much for the doctrine itself, which is unsupported by argument or example, and contradicted by common usage. As to the implement recommended, we admit its usefulness, but do not consider it a new invention, as it has long been customary with many farmers to fit their turnip drills in the front of the frame of their common rollers, by which means, the same saving of time and labour is produced, and the same advantage obtained (though not mentioned by this writer) of not trampling the ground after the seed has been committed to it.

On Draining, by the Use of Mr. Lumbert's Mole Plough, and on an Improvement in the Mode of working it. By R. W. Dickson, M. D.—*Dickson's Agricultural Magazine,* No. 1.

The advantages resulting from the use of the mole plough in draining, in preference to the spade, both in respect to cheapness and neatness of execution, are largely insisted on, and the mode of its application distinctly pointed out: the improvements of Mr. Lumbert in substituting neat clay drains for the main drains, instead of those constructed of stones or bushes, and in working the plough by a windlass instead of dragging it by horses, as at first practised, are spoken of in terms of high commendation; and many suggestions for its use are introduced from Mr. Rudge's recent publication, "The Agricultural Survey of Gloucestershire," and particularly, the recommendation of that writer, first to turn out the sweard or surface, with the common plough, before the mole or draining plough is employed, and make the incision in the centre of this opening, and afterwards return the sod to its place; by which means, the slit made by the coulter of the plough will be effectually covered, and the neatness of the surface be preserved. The windlass adapted to the working of this plough by Mr. Lumbert, consists of a common frame, to be lifted forward by handles, in the centre of which the windlass itself is fixed, and the whole is made steady on the ground by a claw or anchor, which ought to be of strong iron. The plough is brought forward by a chain, which winds round the axle of the windlass, and is kept nearly close to the ground by two friction pullies placed in the frame. The windlass was worked by men by the inventor; but a Mr. Rogers, of Withington, has put a horse to the shaft, and finds that he can pass round by stepping over the chain, without being impeded by its intervention; and one horse is found to do as much work with it as the application of eight men. It is observed, from Mr. Rudge, that in this ma-

chine three desiderata are combined: great power on simple principles—facility in the operation—and cheapness; and the paper concludes with an observation of Arthur Young, in his Annals, that the same principle of the windlass may be usefully applied to the dragging of mud and weeds from ponds, and many other purposes.

Observations.—This article, which is admitted to be founded on some remarks in the Agricultural Survey of Gloucestershire, and in the Annals of Mr. Young, deserves attention only as placing in a new light that which was known before. The application of the capstan to the working of any plough, will never be universally adopted, on account of the inconvenience of removing the machinery from place to place, and the difficulty and uncertainty of fixing it firmly. It must have a very firm claw or anchor indeed to resist the power necessary for drawing forward a mole plough at any moderate depth; and however beautiful the principle may appear in theory, it is too visionary and precarious to be generally applied to practice.

On Irrigation, or Watering of Land. By a Farmer.—*Dickson's Agricultural Magazine,* No. I.

Irrigation is here represented as the greatest improvement in modern agriculture, and as productive of incalculable benefits; as not only improving the ground which is irrigated, but as supplying the farmer with a stock of hay for winter food for his cattle, with spring feed for his sheep, and with increase of manure for his tillage; and all this without any expense except manual labour. The opinion that hay obtained by irrigation is of an inferior quality to that produced on dry land is successfully combated; and it is asserted, that if lands, before they are irrigated, are drained as dry as they possibly can be, and if the fall be sufficient to enable them to be amply so, the hay produced on such lands will be found to be of the very best quality; though if such lands be not previously drained, the hay will be coarse and soft, and unserviceable for cattle. An account is then given of draining and irrigating some land near a trout stream, and the effects of irrigation, and of the mud and slime left by the water, were found to have exceeded previous expectation; and the consequence was, that those who had at first ridiculed the plan, because it was unprecedented, afterwards freely confessed its excellence; the hay was abundant in quantity, and superior in quality to any in the neighbourhood.

Observations.—As the writer of this anonymous article has not annexed to it any date of time or place, and as the editor has not supplied this omission, it is impossible to comment on a circumstance which *seems* only to have had an imaginary existence. The

benefits arising from irrigation are so very widely extended, that it is difficult to conceive any part of the kingdom where, at the present day, the plan should have been unprecedented. Irrigation has been recommended by the *practice* of too many intelligent agriculturists, to stand in need of the plan being advocated by *anonymous writers.*

On Labouring Oxen, and Lucern Grass. By Mr. John Lawrence, *of Somers Town.—Dickson's Agr. Mag.* No. 1.

Mr. Lawrence asserts, that our best labouring breeds of oxen are sufficiently strong, and have sufficient activity, for agricultural labour, and are capable of walking as fast as plough horses generally do, though not so fast as the latter might be forced to do, and are equally docile and equally manageable as horses. The advantage of employing them arises, in his opinion, from two points;—that these labourers may be eaten when their work is done, and that the farmer has at that period a store beast, either to sell at a good price, or to fatten at a new profit. These circumstances appear to him to overbalance every thing which has or can be said in favour of horses. He admits, however, that some breeds of oxen are much better calculated for agricultural purposes than others, and thinks the preference due to the Devon, the Hereford, the Sussex, and the Glamorgan. He has ever considered the prejudice and obstinacy of farming servants as the greatest obstacles to their more general introduction, and replies to many arguments adduced in favour of the use of horses, which had appeared in former numbers of the Agricultural Magazine, concluding with an opinion, that corn, if bestowed upon the ox, will be equally well paid for in labour, as when bestowed upon the horse.

Lucern he always considered very valuable, and reflection has induced him to give a preference to common pasture; for the lucern may be cut twice, while the pasture can be cut only once; and while the latter presents nothing after mowing but withered aftergrass, and is frequently burnt up almost entirely, the former fully covers the ground, and continues widely luxuriant in the driest season, and exposed to the severest winds. Such a contrast as this between the parched and barren grass, and the luxuriant and fruitful lucern, he apprehends, must be sufficient to rouse the attention of the most indolent feeder of stock, and teach him where to give the preference. He thinks lucern may be cultivated more advantageously by the drill husbandry than the broad-cast, from the opportunity afforded by the drill of an entire extirpation of weeds, and thereby of obtaining the lucern pure and unmixed with baser vegetables. In his opinion, lucern ought not to be cut oftener than three times during the summer, and he believes that three cuttings will afford a greater weight of grass than four cuttings at shorter intervals, and points out the advantages of having a grass which luxuriates and abounds in

bulk in dry weather, when the herbage of common pasture land is destroyed by the heat.

Observations.—This writer has long been the professed advocate for the introduction of oxen for agricultural purposes instead of horses, and argues his point with as much force of prejudice, as it can be opposed by those of whose obstinacy he complains: he has, however, placed his subject in many valuable points of view, and his arguments are worthy of attention. The observations on lucern are judicious, though not universally applicable: it is of too cold a nature to form the sole food of animals, and requires to be given with dry food, or natural grasses, to correct this peculiar quality.

On the Advantage of making flooded Grass into Hay, and using it in the Form of Hay Tea. By Mr. John Saunders, *of Stroud. Dickson's Agricultural Magazine,* No. 1.

This communication is stated to have arisen from a reflection on the damage done to the meadow grounds by the floods of the last Spring. It is recommended to the owners of such grass, notwithstanding its mixture with sand, mud, and other dirty particles, to make it into hay, and stack it as usual, and, as they have occasion to use, first to beat it, and then boil it in a furnace in water, so as to form hay tea. The tea may be emptied into tubs or coolers, where the sand and dirt will subside to the bottom, and the liquor may be taken off clear: to this may be added, hay cut short, or steamed potatoes, or carrots, grains, meal, or any other like provender. By these means, says the writer, a person may extract all the virtue and essence of the hay, which would be otherwise lost, and may obtain a palatable and nutricious food for all sorts of horses, cows, oxen, and swine.

Observations.—The recommendation of Mr. Saunders, from the expense, trouble, and inconvenience attending it, cannot, we fear, be frequently followed, and on any very large scale would be almost impossible. His advice is creditable to himself for its ingenuity, but we can see no grounds for believing that his plan can be so generally adopted as to become of much utility to the country at large.

On an improved Plough, for paring and cleaning the intervals of Drilled Turnips, and also capable of being converted to a double mould boarded Plough, for earthing Potatoes, and other similar Crops, planted in wide Rows. By R. W. Dickson, M. D.—*Dickson's Agricultural Magazine,* No. 2.

This implement is stated to have been constructed to enable the cultivator of turnips, and other similar crops, to free his

ground from weeds and rubbish at a much less expense than it could be done by hand. It is constructed on the same principle as a common double mould-board plough, only the mould-boards are not fixed to the machine, but may be taken off or put on by means of hanging them on hinges, in the same manner as a gate or door, and consequently they may be placed at any distance. The implement for cleaning and paring between drilled-rows is effected by removing the mould-boards, and substituting a smaller beam upon a hinge on each side of the plough-beam, in each of which smaller beams hangs a coulter, sharp at the edge, and turned inwards at the bottom, so as not to penetrate the ground, but to skim the surface like a hoe, or the share of a scuffler: these smaller beams, by means of a cross bar over the plough-handles, on which they move and are regulated by pins, may be set in any angle, and the hanging coulters being turned towards each other, pass over the whole surface of ground between the drills, and cut up the weeds. Whether this implement be used as a common double mould-board plough, or as a cleaner, it is furnished at the point with a small share to keep it steady on the ground, and to divide the earth in the centre of the interval between the rows.

Observations.—This plough may produce the intended effect on very level ground, where there are no stones upon the surface, but is entirely inapplicable to a rough and stony soil; for the face of the cutting coulters must either cut through the stones or clods with which it meets, or drag them forward, or, by striking against them, be thrown upwards, and made to pass a short distance without touching the ground. The common horse-hoe, with two or three, or five shares, is certainly a much better implement, because it is equally adapted to all soils, and may be used where this plough could not be kept in order half an hour, as well on a soil with the finest mould. The objections to every agricultural implement which presents a cutting surface parallel to the surface of the earth, have been too fully noticed in the remarks on Mr. Plucknett's mowing and reaping machine, to make it necessary to repeat them:—a reference to that article in our last volume will furnish, we trust, ample conviction of the inutility of this machine as a *cleaner*, and as a double mould-board plough, it is an old instrument. It *has* furnished Dr. Dickson with an elegant Plate to his Magazine, and has certainly been so far *useful*.

An improved Method of fixing the Coulters of Ploughs, and of suspending Casks or Barrels for conveying Liquid Food to Animals. By an Essex Farmer. — *Dickson's Agricultural Magazine,* No. 2.

This method of fixing the coulters of ploughs is, by making use of a cramp, which goes over a pin fixed into the beam at one

end, and over the top of the coulter at the other: the cramp itself takes up and lets out in the same manner as a common pot-hook in a kitchen chimney. The mode of suspending cask, is, merely hanging them by a pin on each side upon the frame of a common wheel-barrow, the part which receives the pin or axis of the cask being raised upon the sides of the frame in the shape of a horse used for sawing wood; or, mathematically speaking, the axis of the cask is placed upon the apex of a triangle, whose base is the side of the wheel-barrow frame.

Observations.—The former of these described improvements may be new, but cannot be more effectual for holding the coulter of a plough firm in its place, than the usual method of wedging it, because the link of the cramp must be stretched beyond the point at which it remains, or it could not pass over the notch in which it lies, consequently when the link is in the notch the coulter is not so tight, as when it passed over the point of the notch; and as to the method of suspending casks on an axis, it has been adopted more than half a century in the dairy counties, where the milk is brought in that manner on the frame of a cart drawn by one horse from the distant milking pens to the dairy: the method is undoubtedly useful, but has no claim to novelty.

On the Management of Woods, and the Conversion of their Produce. By Mr. John Farey.—*Dickson's Agr. Mag.* No. 2.

This communication contains many particulars of the management of woods, in the north-western part of Kent, near Footscray and Farningham, and details the various purposes to which the underwood, or brush-wood, as it is sometimes called, may be most advantageously applied. To enumerate the various divisions adopted to fit this for the market in the most advantageous manner, would be to copy nearly the whole article, which will certainly convey much information to the proprietors of woods; though in this particular it will not admit of a faithful abridgment. Having dismissed his account of the various uses to which underwood may be applied, and noticed the value of each sort, he proceeds to some remarks on timber and bark. He particularly notices that the sap in oak pales, cleaved out directly after peeling, will last nearly as long as the heart, while pales that are cleaved from timber which has laid and dried after peeling, quickly decay in their sappy parts. He deprecates the custom of paying bark-peelers by the yard of bark, as it is stacked to dry, because, in that case, many small arms are left unpeeled, as the peel would be too small and short to stack, and consequently, would not add to the wages of the peeler, and suggests payment by weight as the most equitable method. The implements used in Kent for peeling bark, he represents as much less perfect of their kind, than those used in the Midland Counties, which latter he de-

scribes. They consist of a spud of a roundish shape, flat on its front side, and gradually thickening from the edge, which is sharp to the centre of the back; this is joined to a square iron rod, having its angles hammered down, the upper end of which is fixed and rivetted into a cross handle, like a carpenter's auger; these are of various sizes, and some of these rods are bent circularly, that the tool may be more conveniently applied to force off the bark from the smaller arms; and the cross handle gives an opportunity of applying more force in all cases than the straight handle, which only is used in Kent. He laments the impossibility of preventing the men from hammering the bark in unfavourble seasons, for he asserts, that every place thus hammered, is as effectually spoiled as an apple or pear is by a bruise at the time of gathering.

Observations.—These observations of Mr. Farey, who was some time land-steward to the late Francis, Duke of Bedford, contain much information on a subject which is but imperfectly understood: their value, however, would have been appreciated more highly, if the writer had abstained from holding up to censure the defects in the management of woods arising from the appointment of *Lawyer-stewards* to superintend this species of property; as this circumstance may induce an opinion that they have originated rather from circumstances of *private* history, than from a view of promoting public utility. Be this, however, as it may, the article affords many useful remarks, "on the management of woods, and the conversion of their produce."

On the Management of Cart-Horses. By T. S.—Dickson's Agricultural Magazine, No. 2.

The writer expresses his astonishment at the careless treatment bestowed on cart-horses, and alludes especially to the slovenly but customary way of feeding them in loose and open stables, where the young and hearty feeder will always have the advantage over the aged. To remedy this inconvenience, he proposes a sort of short stalls, four feet and a half wide, and four feet deep from the wall, which will bring the post just behind the horse's shoulder, and leave room enough for covering and harnessing: he suggests that the stalls should be about seven feet high, but not quite up to the ceiling, so as to prevent the circulation of the air; and from the mode in which a horse lies down to rest, he asserts, that a stall four feet and a half wide will afford room sufficient. A plan of a stable for eight cart-horses on this principle, is given from a cutting on wood. With respect to the feeding cart-horses, he offers but few remarks, observing, that it must always depend on the ability and discretion of the owner.

Observations.—This article, together with the plan of the stable which accompanies it, and which appear to have been given

to the editor as an original communication, are merely copied from an article and plate published about six years ago, by Arthur Young, in his Annals of Agriculture, as will appear by a reference to that work. The writer, however, the better to conceal his plagiarism, affirms it to be *a new plan* adopted in his own practice, and extended to several other farms which are placed under his care ! ! !

On Gypsum. By CLERICUS ET COLONUS.—*Dickson's Agricultural Magazine,* No. 2.

THIS reverend agriculturist states himself to be influenced by considerations, which he deems both honest and liberal, in advising experiments with the present fashionable manure ; gypsum, as the most likely means to settle the value of this highly vaunted manure. He remarks that liming, chalking, or manuring with gypsum, to any considerable extent, is matter of serious import, both with regard to the expense, and the chance of an adequate return. Plaster of Paris was, as he observes, recommended in England many years since, and the recommendation has been frequently repeated, but without obtaining the introduction of the article ; and while American farmers, with Mr. Parkinson at their head, state one bushel to be sufficient to manure an acre, he recalls to memory the professions of the famous Baron Van Haake, who undertook to fertilize an acre of land with seven pounds weight only. As to the real merit of gypsum in America, he professes himself unable to speak decisively, from the want of authentic information, but supposes its chief consequence to be derived from the facility with which large quantities may be obtained; and concludes, by stating, that a respectable cultivator has lately published his trial of gypsum, which he has found in no respect superior to chalk or lime.

Observations.—It is evident from the tendency of the observations in this article, that the writer holds the same opinion of the merits of gypsum, as a manure, as the agriculturist to whose expreiment he alludes ; and his motives for recommending the trial of it are obviously to undeceive the public, with respect to the pretended virtues attributed to it by the dealers in the article.

On Turnips on Clay. By Mr. JOHN LAWRENCE.—*Dickson's Agricultural Magazine,* No. 2.

THIS article details information received by an old farming friend of the writer, who resides in the north of Yorkshire. He informed Mr. Lawrence by letter, that last year he conceived the project of preparing for turnips a strong piece of clay, such as never had, and it was the received opinion, never could bear a crop of turnips. His

neighbours did not believe him in earnest, till he actually sowed the seed, and they then attributed his conduct to infatuation. The crop, however, as to quantity, quality, soundness, and flavour, was the best he ever grew in his life; some of the turnips weighed fourteen pounds each. The same farmer has never been successful with Swedish turnips. This example is strongly recommended to the practice of other farmers, and the success is attributed to the very superior cultivation of the land on which the experiment took place.

Observations.—This fact, though contrary to general opinion and common experience, is supported by evidence too strong to be doubted. The great obstacle to obtaining turnips on a clay soil, has ever been held to be the retention of wet and moisture, but where these can be effectually removed by previous cultivation, and draining, we can see no reason why turnips should not succeed on such soils, and if they do, it is probable they will attain a larger size than on soils which are more dry and sandy.

The Irish Method of Curing Beef.—Dickson's Agri. Mag. No 2.

It is stated that the beef shuold be cut up into pieces of eight or ten pounds each, after which it should be well rubbed with fine salt, and put into a cask that will contain pickle. In this cask it should lie eight days, and the cask then be filled up with fresh pickle, made with fine salt and good soft water; and whatever scum rises to the top is to be carefully taken off. After the beef has laid a month in this situation, it should be completely drained and repacked, putting a quarter of a hundred of dry salt, and a half pint of salt-petre into every barrel, to be spread between the layers: the beef should be pressed close with a weight, and when the barrel is headed, a hole should be bored in the side, and the barrel filled up with the old pickle.

Observations.—This receipt for curing beef is not confined to Ireland; it is adopted in principle, if not in exact conformity, in curing beef at the government slaughter-houses for the use of the navy. It is of importance that the meat should be more than covered with the pickle in the first instance, that the scum which rises to the top, and which consists of the fluids extracted from the meat, by the salt, may be completely taken off; for on this point depends the excellence of the pickle. The same principle applies to pickling pork either for navy uses, or domestic consumption.

Description of a New Kind of Agricultural Implement. By M. CAPRIATA, *Member of the Agricultural Society of Turin.—Sonini's Journal, or Rep. of Arts, &c.* No. 64, New Series.

THIS gentleman having frequently remarked that those parts of meadows over which the carts usually passed, produced more hay than the others, provided their passage was not so frequent as to destroy entirely, or too much to damage the turf, made many inquiries to ascertain the reason, but for some time without effect. At length, however, he learned that M. Ratti Casalesco, another member of the same society, used a kind of plough for the express purpose of cutting the roots of grass, in order to make them shoot the more luxuriantly. And when he compared this with a practice common among gardeners of cutting off the points of the main shoots of young melons, in order to multiply the lateral shoots, and of lopping off one branch from a tree in order to obtain a greater number in the same situation, he was convinced that the increased luxuriance which he noticed in the cartways of meadow ground, was occasioned by the roots of the grass having been cut asunder by the wheels. He therefore determined to produce the same effect, by the general application of an instrument, which had been produced before only by accident; and he first tried the plough of M. Ratti, but this he found to disturb the turf too much; and was besides inapplicable to the land which he cultivated on account of the great number of roots of trees, and beds of gravel, which lay immediately within the surface of the turf. As he however considered it material that any dung which might be applied to the meadow should penetrate as deep as where the roots of the grass were divided, he thought it best that the division of the soil and roots should extend quite from the surface to the depth required, and therefore constructed a harrow for that purpose with the teeth sharp on the front edge, but he found this impeded as much as the plough by the transverse branches of the roots of the trees, besides that it collected upon the edge of the cutters all the refuse of the hay which remained on the meadow, so that it required constant cleaning, which was a great loss of time to the workman. On more mature reflection, he judged that an implement possessing the following properties, would answer the wished-for purpose; first, of cutting the turf, and piercing it to a greater or less depth, according to the quality of the land, so that if it is gravelly, the cutter shall go no farther than the superficies; secondly, of not turning up the earth, so that the superficies shall remain undisturbed; thirdly, that when it encounters stones or the roots of trees, it should pass over without cutting or breaking them, and without any damage to the implement itself; fourthly, that although the progress of the implement must necessarily be impeded by meeting with a stone or the root of a tree,

its operation should only be suspended at the single point that happens to come in contact with the impediment, and at no other, for if every stone or root was to render the implement useless in every point on which it acts, it would be of no use at all in a meadow containing many stones or roots, since it would be every instant arrested in some one or other of those points; fifthly and lastly, that it should be capable of executing the operation in a short time on an extensive piece of ground.

He accordingly invented an implement formed on these principles, which he asserts to be undoubtedly useful, but wishes that a mode of construction less expensive could be adopted, that the use of it might become more extensive. The implement consists of a number of concentric wheels, turning on the same axis, which itself remains fixed. The wheels are of two different diameters, and placed alternately on the axis; to the circumference of each of the larger wheels, is fixed with screws a sharp cutting knife, in three or four parts, and the smaller wheels are merely interposed to keep the larger ones at a due and regular distance from each other: the larger wheels are not fitted so close to the axle, but that if any one or more of them come in contact with a root or a stone, they may pass on the surface of the turf without lifting the remainder out of the ground: and as the implement would not of itself be heavy enough to remain in the ground, but would be raised out of it by the resistance of the opposing turf, each larger wheel is loaded with about forty pounds weight of lead run into a circular groove prepared to receive it, or has a circle of lead screwed to it. This implement may be laid on the frame of a common roller, the shoulders of the axis, which are square, being received into appropriate notches made in the frame, and is conveyed to the field on wheels fixed to the frame, of a sufficient height to keep the knives above the road; or the axle may itself be raised between wedges let into the frame with a shoulder, and the machine used in the meadow on the frame with wheels, when the wedges which raised it are removed; and this is the manner in which Mr. Capriata has himself applied it.

Observations.—It is an acknowledged principle of vegetation, that dividing the principal root, or the principal branch of any plant, will cause it to throw out a number of lateral shoots, and the practice adopted by the gardeners in raising melons, affords a confirmation of the theory, that a number of small roots administer more nourishment to a plant than one larger one. It is therefore reasonable to suppose that the same effect would be produced by dividing the roots of grasses; and the intelligent foreigner to whom we are indebted for the first attempt to illustrate this theory by practice deserves the thanks of the agricultural world. To the principles he has laid down for the formation of his machine, we can implicitly subscribe, but the execution of the implement appears to be encumbered with some unnecessary

disadvantages. The friction is much greater in consequence of the larger wheels being kept at their proper distance from each other, by smaller wheels, than if they were kept in their proper places by pins fixed to the axle, inasmuch as in this case a much smaller part of the wheel would come into contact with the dividing body; and the hole through which the axle passes being large enough to admit them to rise on the axle, so as that the knife or cutter may pass on the surface of the ground, will prevent their being steady in their work. It is, however, the first rough design of an implement calculated to introduce a new principle into agriculture, namely, *pruning*, which has heretofore been confined to horticulture only, and as such, is worthy of attention and consideration, and ought by no means to be treated with neglect because it has not attained to all that perfection of which it is presumed to be capable.

A Treatise on the Diseases of Sheep. By ANDREW DUNCAN, JUN. *M. D. F. R. S. E and A. L. S. L.—Transactions of the Highland Society of Scotland, Vol. III.*

THE Highland Society, in 1803, with a view of collecting information on a subject so important as the diseases of sheep, offered a gold medal of forty guineas value for the best essay on that subject; and though the laudable object of the Society was attained in as great a degree as could have been expected, (no less than ten essays of considerable length being transmitted to them, each of which received some mark of the approbation of the Society), yet no one essay was considered in itself, or so superior to the others, as to be deemed worthy of the prize. The Society, therefore, instead of printing any of them separately, put the whole into the hands of Dr. Duncan; and from these original communications and materials this treatise is composed: he states that he did not think it proper, or find it necessary, to consult any other source of information. It therefore does not contain a single fact or observation, which is not asserted on the authority of one of these writers; and that the weight of this authority may be duly estimated, he gives the following as a list of their names: Mr. William Hog, of Mension, in the parish of Tweedsmuir; the Rev. Mr. Singers, of Kirkpatrick; Mr. Robert Stevenson, surgeon, at Gilmerton, in Mid Lothian; Mr. Alexander Welsh, of Easter-Harestain, in the parish of Tweedsmuir; Mr. Thomas Beattie, of Muckledale, near Langholme; Mr. Walter Scott, of Etterick House, in Selkirkshire; Mr. James Hog, of Mitchel Slacks, near Moffat; Mr. Alexander Laidlaw, of Bourhope, in Selkirkshire; Mr. Campbell, of Ormadale; Mr. James Anderson, of Airsdale; and a Gentleman, in Northumberland, whose essay was anonymous.

The arrangement of the materials will be found in the order

which is most natural, not that which is most scientific; for the compiler considered the former to be more perspicuous than the latter.

The LAMB, when newly dropped, is frequently so feeble and defenceless, that it would often perish without extraneous assistance. It is remarked, however, that the size of the lamb, as well as the frequency of twins, is influenced both by the condition of the ewe, and the vigour of the ram; for a well fed flock will produce more twins than one supplied more scantily with food, and twins are also most common in the commencement of the lambing season, the produce of the male before his vigour is impaired. Hence is pointed out the propriety of keeping ewes in good condition, and allowing a plentiful supply of rams; as well as the necessity of keeping the rams apart from the ewes till some particular period, to prevent irregular lambing; and when the lambing season arrives, the shepherd is called upon to be attentive to keep his flock at home, and to prevent others from encroaching on their pasture, and to watch that none perish in holes, or other dangerous places. The ewe being usually much debilitated by the severity of winter, and the pains incident to parturition, will be sometimes apt to die, if neglected, and sometimes unable to lamb without assistance; but when the lamb is brought forth, if it be healthy, and the weather good, it will in a few minutes search for suck, and after getting it seldom perishes from cold: as, however, the inclemency of the weather not unfrequently destroys the lamb before it reach the ground, the necessity of carefully observing the point from which the wind is likely to blow, and of conducting his flock to the most sheltered situation, is strongly inculcated on the shepherd; and one man is stated to be sufficient to attend to four hundred ewes in a moderate season. It is observed, that lambs depend entirely on milk for their sustenance for the first fourteen days, though they may be found nipping the grass; but though wanton and playful, they are even in this early state subject to many diseases.

HUNGER is reckoned among the most frequent. A lamb perishing from hunger appears hollow at the flanks, has a weak and mournful cry, is very apt to follow any sheep that comes nearest to it, and is either unattended by its mother, or if it attempts to suck her, she springs forward and will not suffer it to touch her. It may, therefore, easily be discovered among the flock, and should be immediately put into an inclosure with its mother, that her behaviour and disposition may be more closely observed, and if, on examination, her nipples are found to be sore, they should be anointed with some emollient ointment, such as simple cerate, and if she has little or no milk, she should be supplied with plenty of green food, which will produce it in great abundance, and in the mean time the lamb should be often fed with ewe's milk. And in case a lamb should die, and it is found desirable to give

another to the mother, it is recommended to cover the lamb to be adopted with the skin of the dead one, and to confine it some days with the mother, and when it is at length permitted to suck, it runs no hazard of being repulsed or deserted.

Being sick of the MILK, is a term applied to lambs, when they appear spiritless and dull, with their ears lying asunder on the head, instead of being upright; this disease is frequently succeeded by a purging: but as it never affects after three weeks old, no remedies or preventives are recommended to be tried.

PINDING is another disease exclusively confined to sucking lambs, and which is described as the adhesion of the excrement to the tail and buttocks, and when hardened by the sun, sometimes glues them so closely together, that there is no possibility of an evacuation, and the intestines soon mortify. The disease is easily discovered, and when noticed, its immediate recurrence is said to be prevented by rubbing the parts over with friable clay or mud, for eight or ten days, till they begin to eat grass, when all danger from this obstruction is at an end.

INFLAMMATION OF THE BLADDER is said to attack some few of the males in the first ten days, and sometimes proves fatal; but if they are removed to a different pasture, they will frequently recover.

GRASS ILL is also liable to affect lambs, when about three weeks old; but on account of the violence of the symptoms, and its speedy termination in death, no remedies are offered.

STIFF JOINTS will affect a few lambs in a flock, in the month of June; but as this disease is occasioned by the low state of the dam, and as at that time they are disposed to grow very fast, they generally recover, though they become stunted ever after.

The LOUPING ILL sometimes causes a considerable loss of lambs; it is an affection of a paralytic nature, and though sometimes lingering, yet is sometimes so speedy, that the animal is dead before the disease is suspected. Washing in cold water is said to have been adopted with considerable success.

CASTRATION is usually performed upon tup lambs, when they are about eight weeks old. As the operation is painful, and sometimes fatal, it is observed, that it should never be done when there is electricity in the atmosphere, when the nights are frosty, or when it rains heavily, but in clear mild weather, or during mild thaw, and that care should be taken that the lambs be not previously heated by driving or catching; and after the operation, as much attention as possible should be given, that the lambs do not get sand or dirt into the wound, or irritate it in any other way. If there is to be any great loss from the operation, it will be evident the second day, though some die on the day of the operation, but the greatest mortality is on the third or fourth; and as death in this case is caused by mortification, nothing will arrest its progress. A remarkable fact is related from the Rev. Mr. Singers,

which deserves notice.—"Mr. W. Gibson, on his farms in Crawfordmuir, in Lanarkshire, suffered great loss one season in his wedder lambs, after being cut. To his astonishment some of the ewe lambs sickened, and died with highly putrid symptoms; the disorder had risen into the form of a putrid fever, which became at last infectious."

Lambs are exposed to various accidents, such as drowning, falling into pits, and being destroyed by beasts or birds of prey. The mode by which it is said an experienced shepherd can determine if a lamb be lost in any of these ways, is both curious and instructive. "If it has fallen into a pit, the dam runs away in a frantic disordered state, utters a wild sort of cry, comes hastily back, and if she be allowed will look into the hole or pit where it is. When destroyed by any bird or beast of prey, her behaviour is still more disordered; she runs about from one of her neighbours lambs to another, and the tremor of her voice indicates the perturbation of her mind. It requires the most skilful management to get a ewe which has lost its lamb in this way to adopt another."

Weaning lambs is represented as a matter of great difficulty and considerable delicacy, especially if their number be large, and their pasture inconvenient, and every precaution should be observed to prevent them from wasting themselves by running, particularly in passing to and from the fold; and it is recommended not to pasture them at a great distance. It is observed, that the ewes will cease to have any milk in ten or twelve days; after which time the lambs may be left at liberty, when they will return to their former pasture, and associate ever afterwards with their mothers; and many interesting occurrences are recited in recommendation of this practice, whenever the mothers are intended to be continued on the farm, but where they are to be fattened and sold off, the separation between them and their lambs is advised to be regularly continued.

The Sickness, or as it is called by some the Braxy, is described as the most quickly fatal of all the diseases to which sheep are liable, since six or seven, or sometimes more, are carried off in the course of one night, out of a flock of three hundred. When the progress of this disease can be observed, the animal seems to become uneasy, and ceases to feed, but, when it has an opportunity, drinks freely: the eyes are found to be half closed, inflamed, and watery; the mouth, tongue and skin dry and parched; the pulse strong and frequent, and the breathing quick and difficult. It avoids the company of the rest of the flock, and expresses its agony by bleating, or rather screaming; the rim of the belly sometimes gives way, and strong convulsions are succeeded by death, sometimes in a few hours after the first attack. It sometimes however happens, that the animal will live several days, but seldom a week, unless they recover, which is a rare occurrence, and if the body be examined after death, almost every part of it ex-

hibits appearances of putrefaction. The causes of this disease are offered only on conjecture, and the length to which the account is extended forbids an investigation of the various speculative opinions. It is admitted that the disease itself may almost be said to be incurable; and even if a specific were discovered, it would be of little value, as the animal frequently dies before it is known to be attacked. If in any instance a cure is at all possible, it can only be hoped for from such means as are calculated to counteract inflammation. Yet Mr. James Hog recommends a method of cure which is in the power of every shepherd, and for the efficacy of which he vouches from his own experience. If the animal be found in the early stage of the disease, he advises the shepherd to hunt it well, till it be in a severe heat, and follow after it, that it lie not down immediately on leaving it, and if it will lie down let it be in a house. He asserts, that many shepherds have discovered this method of cure by chance, who yet are ashamed to confess that they are indebted for success to so simple a remedy. He also thinks bathing in warm water may be beneficial for eight or ten minutes, if some water-gruel and butter be given as an injection at the same time. And since so little can be done in curing this disease, it is observed that our principal efforts should be directed to find out a preventive. As this disease is most prevalent among hogs, or shear-hogs as they are called, (sheep of the first year), it is advised to pasture them among the old sheep, that they may learn from experience a proper selection of food, and the proper times of collecting it, since errors in these points are frequently the forerunners of the disorder. A moderate use of turnips is also named as a certain preventive. Mr. Singers remarks, that experienced shepherds have found benefit from visiting their young sheep every morning at an early hour, when the approach of sickness is dreaded; for if any danger arise from external cold, the sooner they get up and move about the better. Bleeding is recommended by Mr. Campbell, but it is an operation attended with much difficulty; and all kind of medicines are strongly reprobated: and when the sickness makes its appearance in a flock, the best way of checking it is stated to be giving them turnips on their own pasture, or removing them to another situation, where they can get plenty of succulent food.

Trembling, Thwarter, or Leaping Ill, are appellations applied in different parts indiscriminately to all diseases, which, on a dry soil, proceed from a debilitated state of body, and barren seasons. This disease affects sheep of all ages and kinds, but never when in good condition. It prevails chiefly on dry farms, having a northern exposure, and its production is favoured by a long continuance of easterly winds. It frequently assumes the appearance of palsy, and takes away the use of some of the limbs. As the disease is thought to arise from the brain being oppressed by too much blood being conveyed there by the quickened circulation, copious blood-letting is recommended on the first appear-

ance of the disease, which will be more effectual if taken from the veins of the neck, or from a vein on the outside of the eye, generally well known to shepherds; and as there is too great a determination of blood to the head, it is conceived to be advantageous to make a determination to the bowels, by stimulating them by purgatives, such as an ounce of glauber salts, mixed with ten grains of calomel, or a dose of half an ounce of nitre; and these remedies should be persevered in till the symptoms disappear. But if the animal be far gone, and has lost the use of the limbs, it should be killed for the sake of the carcase, which in this disease is but slightly affected.

Cramp of the Legs, which is also by some denominated the wood-evil, seizes the legs of sheep, and makes them totally incapable of walking; the action of the nerves of the legs being so much impaired by cold, as to destroy their energy. Mustard is mentioned as a remedy to be given internally, a tea-spoonful night and morning: but the most effectual method of removing the complaint is stated to be rubbing the parts affected with warm flannel, and keeping the sheep dry; and if rubbing does not succeed, a little oil of turpentine may be applied externally with much advantage.

The Sturdy is represented to be a disease of considerable importance, both on account of its frequency, and because it always proves fatal unless when relieved by art. When a sheep is attacked with one species of sturdy, it ceases to improve, becomes dull, and separates from the rest of the flock; it does not walk straight, and the eyes glare in the head, and seem enlarged; its vision is impaired and indistinct, and it frequently starts and runs furiously without any aim. Some time after these symptoms appear, on examining the head, by pressing with the thumbs, a remarkable degree of softness is found at one part of it, where the skull seems to be wanting. In a few instances, no softness is to be discovered in any period of the disease; but in either case, if not relieved by operation, the animal loses the power of standing, and dies perfectly emaciated. There is, however, another variety more rapid in its progress, in which stupor is in a few days followed by total blindness, and no softness is ever to be found in any part of the skull. The cause of the symptoms is undoubtedly pressure on the brain, and is stated to arise from accidental contusion, or a bony excrescence, which is called the false sturdy, or from a collection of water, which is the true sturdy. The termination of this disease is invariably fatal, except in rare recoveries, which sometimes are the consequences of accidental blows on the head, probably rupturing the bag which contains the water. The cure, however, may be attempted by three ways; tapping, trepanning, or wiring. *Tapping* is performed by perforating the soft place of the skull with an awl, or large corking-pin; although an instrument with a small tube in it might be made, which would drain it off more completely. No injury

arises from this operation, if the instrument is not pushed too far. *Trepanning* is very minutely described from Mr. Stevenson's Essay. He recommends the animal being properly secured, and the head placed in the most convenient position, having the part to be cut uppermost; the skin is then to be divided by an incision an inch and a half long, crossed by another of the same length at right angles to it; the skull, which is quite soft, is to be cautiously divided in the same manner, till the bag with the fluid appear clear at the bottom of the incision, which it commonly does; the skull is then to be turned back and opened, and the bag taken hold of by a pair of blunt forceps, and gently moved backwards and forwards so as to loosen it; and assistance may be obtained by carrying a crow-quill, or any blunt-pointed instrument, frequently round it. The animal is to be prevented from breathing through the nose; and the operator, by stopping the breath, and pulling the bag alternately, will soon extract it, after which the wound is to be closed, and covered with a plaster, and may be expected to heal with a few dressings. *Wiring* is performed by thrusting a stiff sharpened wire up each nostril, until it stop against the upper part of the skull. Mr. James remarks, that if a cure by this method was not well authenticated by daily observation, it would seem very severe and dangerous, as the wire goes quite through the brain in two different places: and this singular operation is considered the safest and most successful by Mr. William Hog and Mr. Scott, who say, that after they are wired, sheep will lie as if dead for many hours, and still recover.

Staggers is a disease seldom affecting sheep, except those which are fed in forests and plantations. The symptoms are a general trembling and giddiness, and often prove fatal. The only effectual cure for it is change of pasture.

Pining, Daising, or Vanquish, is almost peculiar to the western parts of Scotland, and is most severe upon young sheep. It reduces the animal to a mere skeleton, and as it is supposed to be occasioned by rank and obnoxious grasses, change of food generally prevents it.

Diarrhœa is produced by the early grass of soft pastures, which are subject to be inundated in the winter and spring: this is eagerly sought after, and greedily devoured by sheep. In this disease, it is recommended to remove the animal to dry food, and to administer every morning and evening a gill of decoction of logwood, formed by boiling a quarter of a pound of logwood in a quart of water, with a little cinnamon; and if a cure is not produced in eight days, ten grains of catechu, or twenty drops of laudanum, should be added to each dose.

Dysentery is in every respect analogous to the same disorder in the human species, is attended with the same symptoms, and yields to the same remedies; and if the animal survives the disease a fortnight, it generally recovers. The most usual remedies are stated to be Peruvian bark, and other astringent medicines, but a

few drops of laudanum in every dose are recommended as a valuable and important addition.

The SCAB or ITCH is a disease too generally known to need description: the infected sheep becomes restless, and instead of feeding, tears off the wool with its teeth; the skin has a red fretted appearance, and emits a peculiar ichor, which hardens into a scabby crust. The disease is highly contagious, and when once introduced into a flock, lessens its value more than one half, for it quickly infects the whole. It is therefore recommended to remove from the flock every infected sheep as soon as it is discovered, to prevent the spreading of the disorder. It is, however, by no means incurable. Mr. Stevenson recommends a tea-spoonful of brimstone and treacle to be administered every morning; and several external dressings are recommended, the basis of all of which is sulphur, with the single exception of a recipe of Sir Joseph Banks, which consists of a salve, made from one pound of quicksilver, half a pound of Venice turpentine, half an English pint of oil of turpentine, and four pounds of hog's-lard: the quicksilver and Venice turpentine are to be first rubbed together in a mortar, till the globules of the mercury disappear, and then the oil of turpentine and hog's-lard are to be added. The ointment, thus formed, is to be applied in a furrow between the divided wool from the neck to the tail, and in similar furrows branching from this down the shoulders and thighs to the legs, as far as they are covered with wool; and the common mercurial ointment may be used in the same manner. Mercury is stated to be a more effectual, though doubtless a more dangerous remedy, for this disease than sulphur.

REDWATER produces many eruptions on all parts of the skin, but is very rarely fatal. The following receipt is given as an effectual remedy.—"Take of flower of sulphur, two ounces, and of honey, treacle, or syrup, three ounces: mix them, and divide them into six doses, one of which should be given every morning in half a pint of warm water.

ERYSIPELAS, or WILD-FIRE, infects the skin like the last mentioned disease; and, if not attended to, will quickly spread through the flock: it seldom continues above eight days, and may be cured by the same medicine as the redwater, and an ounce of salts given every morning for three or four days, is equally effectual.

FOOT ROT is a disease which seldom occurs in clean pastures but is frequently troublesome on those which are dirty: it is stated, to prevail mostly in the month of August, and commonly to affect the fore-feet, but sometimes all four: the seat of the disease is the outer part of the hoof. As soon as it appears, the foot should be examined and opened, and the matter let out: it is advised afterwards to wash it well, and dress it with mercurial ointment; it should then be bound up in flannel, and kept clean and dry till the animal recover.

Leg-evil is a complaint arising most commonly among the South-down and Leicester breeds, but after it appears in a flock, other breeds are equally subject to it: it is attended with severe swelling, and as it is frequently dangerous, the sheep affected should be brought home as soon as possible, and its legs well washed with soap and water, and afterwards bathed with lime-water, and anointed with an ointment made with mercury dissolved with *aqua fortis*, and mixed with hog's-lard; or if this be not at hand, a little lime may be dusted on the wound, and the leg dressed with tar or fresh butter; which dressing should be changed every second day.

Tag consists of scabs and sores on the under side of the tail, arising in warm weather from frequent purging: it is recommended to wash and anoint it with grease and tar mixed together, and to supply the sheep with dry food.

Vermin molests sheep of all sorts and ages, but particularly those that are lean and young. Smearing with tar is said to expel it from the skin, and afterwards drop from the wool. Tobacco juice is stated to be almost instantaneously fatal to the tick, and unslaked lime is named as the best cure for the fly: when maggots prevail, directions are given for carefully picking out the vermin, and washing the infected parts with soap and water, or an infusion of tobacco, and anointing them with tar.

Jaundice, or Head-Ill, or Gellows, is a common disease among sheep, and has been variously described; the symptoms however are said to be a yellowness over the body, which is particularly observable in the white of the eye, and the urine tinges any thing of a yellow colour which is immersed in it. The most promising method of cure is stated to be a selection of salt in water, which tends to promote regular secretions, though some recommend sulphur in warm milk, or salt-petre in common water.

The Dropsy in sheep, is said to be rather a symptom of other diseases than a disease itself; a dry sheltered walk is recommended as a preventive of this disease, and two drachms of cream of tartar given twice a day with a plentiful supply of hay will always have a good effect, and sometimes work a cure.

Blindness in sheep, though not a fatal disease in itself, yet exposes the animal to so many accidents, that where it cannot be cured by abating the inflammation, or by destroying the film over the eye, by bathing it with a solution of sugar of lead, it is recommended to kill the animal.

The Accidents to which sheep are liable, are next enumerated, but they are too various and too uncertain to make it necessary to investigate them particularly.

The Rot or Poke is said to have become less frequent from the effect of modern improvements in sheep-farming. The causes and character of this disease, are however minutely recited by Mr. James Hog, who is decidedly of opinion, that it is always occa-

sioned by a too quick transition from fatness to leanness; and he asserts, that though this opinion may be supposed new, it is nevertheless corrrect; for he says, there never were any sheep known to rot, while they continued at good equal maintenance, unless otherwise abused, and that none ever will rot, kept on pasture which does not feed them very fat, or allow them to fall away below a medium. He thinks the *quality* of the food in the autumnal quarter has a more immediate influence on their constitution, than what they eat at any other period, and that therefore this point should be particularly attended to; and all rank and luxuriant grasses, proceeding either from floods, or an excess of manure, he considers very detrimental; and is of opinion, that over-heating sheep in autumn by severe dogging, or rash and inconsiderate management, has also the worst effects in breaking their spirits, and wounding their constitution. He observes, that the rot never affects sheep that have plenty of food and good shelter, and illustrates the observation by remarking that pet-sheep never suffer from this disease, though their food is often of a very improper nature. Some preventives are mentioned against this disorder, the principal of which is draining the ground on which the flock usually feed. With respect to the cuer of it by medicines, it is observed, that little can be said with certainty; the following receipt however is recommended as efficacious. "Steep four pounds of antimony in two gallons of ale for a week, and give the sheep a cupful of it night and morning."

The treatise is concluded with an appendix of nine articles, but these relate rather to observations on the management of sheep, than to the diseases to which they are liable: it is considered unnecessary to protract so long an article by adding an examination of them.

Observations.—This long treatise, which is extended through more than 150 pages of the volume, certainly contains much interesting matter, and is well deserving the attention of the sheep-master. The symptoms of the different diseases are too minutely described to admit of mistakes by a careful observer, and the remedy generally offered with becoming diffidence. The appearances on dissection after death are also accurately detailed, though it was found expedient to pass them over in the abridgment, as tending to lengthen still more, what may be deemed too long already. The names of the gentlemen who furnished the essays from which the treatise has been compiled, stamp upon it a character for truth and accuracy, and Dr. Duncan the compiler appears to have executed his part with justice to the individual writers, and at the same time rendered it useful and instructive to agriculturists in general.

On Planting Osiers. By Mr. John Shuckford Wade, *of Benhall, Suffolk.—Trans. Soc. Arts, Vol.* 24.

This gentleman obtained the silver medal of the Society, for planting fifteen acres and a half of osiers, with upwards of 12,000 sets to an acre. As he conceives that it might convey some information on the subject to those who are unacquainted with this kind of culture, he remarks, that the names given to osier-plants cultivated in Suffolk, are, new green osier, leathering osier, French rod, motely rod, and craneker. The plants are usually set at a distance from each other of 26 inches by 10, and are found to grow best near the rivers. The expense for sets nine inches long he computes at about ten pounds per acre, besides an additional expense of two guineas, for preparing the land, in ploughing and harrowing, and in planting the sets. He thinks a greater profit cannot reasonably be expected, than ten pounds per acre, for the plants are very subject to the depredations of insects, and are particularly injured by a brown bug, which is followed by a black caterpillar, which makes them crooked, and entirely kills the top: besides this, new sets are continually wanting: so much injury had accrued to one plantation belonging to him from the prevalence of this insect, that he was obliged to stub up all the osier-plants, and after cleaning re-set it with fresh ones. He holds it absolutely necessary to keep the beds perfectly free from weeds for the first two years.

Observations.—The cultivation of the osier has been found to be very profitable on most soils, but particularly on low lands, which from being overflowed by floods, are often incapable of being applied to other uses from the stagnant waters converting them into a kind of swamp. On plots of ground of this description, nothing else can be advantageously cultivated. It is necessary however to plant the osiers on beds intersected by very deep trenches, the earth out of which should form the beds, by which means the plants will be raised above the constant standing of the water, and will grow more luxuriantly. The expense of planting is certainly great in the first instance, but as the crop may be cut every second or third year, it will in a short time be amply compensated.

A Method of Feeding Cows during the Winter Season, with a View to provide poor Persons and Children with Milk at that Time. By J. C. Curwen, *Esq. M. P.—Trans. of the Soc. of Arts, Vol.* 24.

Under an impression that the Society would readily extend their indulgence to an experiment, which might prove highly be-

neficial to the lower orders of society, and at the same time tend to the advancement of agriculture, this gentleman determined to try an experiment of feeding milch-cows after a method very different to what was in general practice. With this view he made a provision of cabbages, common and Swedish turnips, khobrabi and coleseed; and also made use of chaff boiled and mixed with refuse grain and oil-cake; and he used straw instead of hay for their fodder at night. The greatest difficulty he experienced was to prevent any decayed leaves being given, and when this precaution was attended to, the milk and butter were excellent. From want of experience, and having had no previous knowledge of the management of a dairy, his first experiment was conducted with that frugality requisite to produce much profit; but the second year of the experiment he was much more successful, and gained a profit of nearly five pounds on each cow. The cows treated according to this plan were in excellent order both seasons, and were allowed to be superior to any in the neighbourhood.

Observations.—This experiment, which displays as much philanthropy as it does agricultural knowledge, may afford much useful instruction to the cottager, as to the means of keeping a cow through the winter; but it will never be resorted to in an extensive dairy where hay and green food can be conveniently procured. In the Northern and Eastern counties however, where hay is both scarce and dear, it may be more generally resorted to for a supply of milk; but we imagine the milk so obtained will not be productive of much butter.

Account of the Improvement of a Moor, near Tranent, East Lothian. By Mr. Robert Hay.—*Trans. of the Highland Soc. Vol.* 3.

The moor in question never paid one shilling an acre up to 1799; the soil is black, moorish loam on a hard stone bottom, and the surface very uneven. Instead of levelling it, as he was generally advised, Mr. Hay traced out the low ground, and drew cross furrows, which being kept clean, laid the whole so dry, that no water stagnated on the surface: he afterwards levelled the ground by removing the earth in carts, and the crop (oats) was equally good all over the ground. From an account of the expense and the produce, which is subjoined, the profit appears to be considerable.

Observations.—Wherever this method of draining moor-land is practicable, it is certainly preferable to ploughing the soil in the first instance, as a better judgment may be formed with respect to moving the earth, when the whole becomes dry. And on a small scale, we think it preferable to the plan of Mr. Phillips of Tyn-y-shos, noticed in our last number from the communications to the Board of Agriculture.

CHEMISTRY AND MINERALOGY.

On some Chemical Agencies of Electricity. By HUMPHRY DAVY, *Esq. F. R. S. M. R. I. A.—Phil. Trans.* 1807. Part 1.

WE have already given in vol. 2, p. 470, some account of this very interesting paper, from our recollection of it, when read at the Royal Society, but now proceed to furnish our readers with a more detailed abridgment from the printed copy.

The chemical effects produced by electricity have long been objects of attention, but the novelty of the phenomena, their want of analogy to known facts, and the apparent discordance of some of the results, involved the inquiry in obscurity.

It was very early observed by several persons that both an acid and alkaline substance, appeared in water acted upon by a current of electricity; but it was soon conjectured, that the muriatic acid came from the animal or vegetable matters employed to connect the two portions of water; this conjecture Mr. Davy found to be true, for when the same cotton was repeatedly used to connect the tubes containing the water, the acid ceased to be evolved. The soda, which had also been observed, was found to proceed from the corrosion of the glass tube containing the water, as it did not appear when water was electrified in an agate cup. Mr. Sylvester imagined he had found a fixed alkaline matter when he used a vessel of tobacco pipe clay to contain the water, because the residuary fluid rendered turmeric brown, but this might be occasioned by lime, which is contained in the pipe clay, and the same source might also have afforded some soda.

To be more certain of these effects, some distilled water was electrified in two agate cups, by the current of electric fluid from 150 four inch plates, the communication between the cups being formed, according to the excellent invention of Dr. Wollaston, by moistened amianthus. In the first experiment soda was produced in the negative cup, but the quantity was much less than when glass tubes were used, and on repeating the experiment its quantity decreased, so that in the fourth experiment, the presence of soda was scarcely perceptible in the residual water. The water in the other cup was sour, and appeared to contain nitrous acid with excess of nitrous gas. As similar effects were produced by electrifying water in small gold cones, it was suspected that some minute portion of saline matter had been carried over during the distillation of the water, notwithstanding the water did not affect nitrate of silver, and muriate of barytes. On evaporating a quantity of this water in a silver vessel by a heat not exceeding 140° Fahr. a small residuum was actually left, which appeared to

be a mixture of nitrate of soda, with nitrate of lead. A portion of this residuum being added to water, electrified in the usual manner, that had attained the maximum of its effect upon turmeric paper, considerably increased those effects.

The water thus slowly redistilled, being electrified either in gold cones, or in agate cups, did not evolve any fixed alkaline matter, although it exhibited signs of the presence of ammonia. When cups made of wax were employed, both soda and potash were evolved, and the acid matter in the positive cup was a mixture of the sulphuric, muriatic and nitric acids. In a tube made of resin, the alkali was principally potash. In cups formed of Carrara marble, primitive marble from the highest mountains in Donnegal, argillaceous schist from Cornwall, serpentine from the Lizard point, and grauwacke from North Wales, an uniform evolution of soda was observed. This probably arose from a minute portion of common salt being contained in them, arising from their having been formerly covered by the sea, notwithstanding the height at which they were now found above it. The Carrara marble yielded a sensible quantity of common salt on being analysed, and on repeating the experiment in the cup formed of it, the presence of soda became less visible every time, and at length disappeared entirely; but the production of lime-water was constant. A bit of glass added to water that was subjected to experiment in the gold cones, caused it to exhibit almost immediately the presence of soda.

In all these experiments, nitrous acid was constantly found in the positive cup, and this acid seems to be produced from the combination of the nascent oxygen disengaged on that side with the nitrogen of the common air, that had been absorbed by the water. The longer the operation was continued, the more acid was produced, as the common air continued to be absorbed. Volatile alkali was also constantly formed in the negative cup, from the combination of the nascent hydrogen disengaged on that side with the nitrogen of the air contained in the water; but this formation soon attained its utmost limit, as hydrogen during its absorption by water, seems to expel nitrogen. When water was subjected to experiment in vacuo, scarcely any nitrous acid, and no volatile alkali was formed. And in another experiment when the tubes were inclosed in a receiver previously filled with hydrogen gas, and the common air originally contained in the water had been extracted by the air-pump, neither nitrous acid, nor volatile alkali were found in the water.

In all these processes, the acid substances collected in the water that surrounded the point transmitting the electricity, and the alkaline matter round that which received it. When water was even electrified in two cups made of sulphate of lime, the water connected with the positive wire contained sulphuric acid, while that in the other cup, was a pure and saturated solution of lime. Similar effects were produced, when use was made of

cups, formed out of sulphate of strontites, fluate of lime, or sulphate of barytes. Very minute portions of acid or alkaline matter, might be disengaged by this means from solid combinations, consisting principally of the pure earths; for when cups were used that were made of a fine grained basalt, from Port Rush in Antrim, which was found by a careful analysis, to contain $3\frac{1}{2}$ per cent. of soda, about $\frac{1}{2}$ of muriatic acid, and 15 of lime, oxymuriatic acid was found in the positive cup, and a mixture of lime and soda in the other. A cup of compact zeolite from the Giant's Causeway, that contained 7 per cent. of soda, yielded soda and lime to the water connected with the negative wire. Lepidolite yielded potash, and vitreous lava from Etna, yielded a mixture of soda, potash, and lime.

In order to ascertain whether the weight of the alkali thus obtained, agreed with the weight lost by the substance operated upon; water was electrified negatively for four days, by a current from 150 plates in a glass tube, that weighed 84 $\frac{56}{128}$ grains. The positive wire was inserted into water contained in an agate cup, and the communication was formed by moistened amianthus. At the end of the process, the tube weighed 84 $\frac{37}{128}$ grains. The water on being evaporated, yielded $\frac{36}{128}$ of a grain of a mixture of soda with a white powder that was insoluble in acids. So that there was no doubt but some minute detached particles of amianthus were present, and the soda itself must have contained water, from which it was entirely free in the glass.

When compounds soluble in water were put into water contained in agate cups, and electrified, the decomposition was much more rapid. A solution of sulphate of potash being put into each of the cups, and electrified by means of 50 pairs of plates for four hours, the acid was found by itself in the positive cup, and the alkaline basis in the negative cup. Similar phenomena took place with solutions of sulphate of soda, nitrate of potash, nitrate of barytes, sulphate of ammonia, phosphate of soda, succinate, oxalate, and benzoate of ammonia, as also with alum. When muriatic salts were used, they yielded oxymuriatic acid. If compatible mixtures of neutro-saline compounds were used, the different acids and bases separated in a mixed state, without any regard to their affinities. When metallic solutions were employed, metallic crystals, or depositions, were formed on the negative wire, and oxide was likewise deposited round it; at the same time, a great excess of acid was soon found in the positive cup. This effect took place with solutions of iron, zinc and tin, as well as with the more oxidizable metals. When muriate of iron was used, there was deposited on the negative wire, a black magnetic substance, that was soluble with effervescence in muriatic acid; and when sulphate of zinc was used, a gray powder possessed of the metallic lustre, and likewise soluble with effervescence, was deposited on the negative wire.

Although stronger solutions afforded signs of their decomposi-

tion quicker than weaker ones, yet even the most dilute solutions seemed to be acted upon with equal energy. Thus, paper tinged with turmeric, was immediately rendered brown when plunged even into pure water, and brought in contact with the negative point, in consequence of the very minute portion of saline matter contained in the paper. In the same manner, and from the same cause, paper tinged with litmus was immediately reddened by being brought in contact with the positive point. And in all these decompositions, the separation of the constituent parts from the last portions of the compounds, was complete when the operation was sufficiently protracted.

In the same manner, the acid, or alkaline elements of compounds could be transferred from one electric surface to the other. Pure water being electrified in cups of different substances, it was found that when the cup made of sulphate of lime was positive, and that of agate negative, the first contained sulphuric acid, and the other lime-water. On reversing the position of the wires, the agate cup contained sulphuric acid, and the other lime water. Similar effects took place when pure water contained in one glass tube, and a neutral or metallic saline compound in another tube, were connected by moistened amianthus, and electrified. The acid always passed into the water when it was positive, and the alkali, when it was negative: the metals and metallic oxides passed like the alkalies, and collected round the negative point. When solution of nitrate of silver was positive, and water negative, the transmitting amianthus was covered with a thin metallic film. The time required for this transmission, seemed cæteris, paribus, to be as the length of the intermediate volume of water.

The immediate contact of the solution to be decomposed with the wires, was not indispensably necessary for its decomposition. A solution of muriate of potash being put in the middle tube of a series of three tubes, the two outer tubes containing only water and the wires, alkali soon appeared in that connected with the negative wire, and acid in the other: and at length the acid and alkali were obtained perfectly separate.

In thus causing sulphuric acid to be transferred from sulphate of potash into water through moistened amianthus, no change was observed to take place, in paper tinged with litmus, placed near the amianthus. The reddening of the tinged paper always took place just above the point of the positive wire, and then slowly diffused itself to the middle of the tube, but no redness appeared above the amianthus, or about it on the negative side. Similar effects were observed, when the alkali was transferred, paper tinged with turmeric first becoming brown close to the negative wire.

When three glass tubes were used, the two outer tubes holding a solution of muriate of soda, and the middle one sulphate of silver; paper tinged with turmeric, was placed on the positive

side, and paper tinged with litmus on the other, neither of the papers had any change made in their colours, although the muriatic acid passing through the amianthus occasioned a dense heavy precipitate in the sulphate of silver, and the soda a more diffuse and lighter one.

Acid or alkaline substances will also pass through liquids, having a strong attraction for them. In an apparatus composed of three tubes, it was found that sulphuric acid after being evolved from a solution of sulphate of potash, contained in the tube connected with the negative wire, would pass into water contained in the tube connected with the positive wire, through either ammonia, lime-water, or weak lixivia of potash, or of soda. The only effect of strong lixivia of potash, or of soda, was to increase the time necessary for this transfer. Muriatic acid, or nitric acid, were also transmitable in this manner through alkaline solutions; and *vice versâ*, alkaline matter, by changing the arrangement of the liquids, was transmitable in a similar manner through the acids: even magnesia was transferred like the other bases. But, however, when it was attempted to pass sulphuric acid through aqueous solutions of barytes, or of strontites, or, on the contrary, to transfer these earths through sulphuric acid, the sulphate of those earths was deposited in the intermediate tube.

Metallic substances required a longer time than the alkalies, to pass through acid solutions. When a solution of green sulphate of iron was positive, muriatic acid intermediate, and water negative, green oxide of iron began in ten hours to appear on the amianthus on the negative side, and in three days, a considerable portion of this oxide was deposited in the tube. Analogous results were obtained from solutions of sulphate of copper, nitrate of lead, and nitromuriate of tin.

Water being positive, a solution of sulphate of potash intermediate, and a solution of muriate of barytes negative; sulphuric acid, and afterwards muriatic acid were found in the water.

A solution of sulphate of potash being positive, a solution of muriate of barytes intermediate, and water negative; barytes first appeared in the water, and afterwards potash.

A solution of muriate of barytes being positive, a solution of sulphate of potash intermediate, and water negative; potash appeared in the water, and sulphate of barytes was deposited in the intermediate vessel, while no barytes passed over into the water, not even in ten hours.

Water being positive, a solution of sulphate of silver intermediate, and a solution of muriate of barytes negative; only sulphuric acid appeared in the water, and muriate of silver was deposited in the intermediate vessel.

Several of these experiments relating to the transference of acid and alkaline matter were tried with vegetable and animal substances. When a fresh leaf-stalk of polyanthus was the medium of communication between a solution of nitrate of strontites posi-

tive, and water negative, free nitric acid was found in the positive tube, and potash and lime passed immediately into the water; but it was not until after some time, that strontites appeared in the negative tube.

When muscular flesh of beef formed the communication between a solution of muriate of barytes and water, free oxymuriatic acid collected in the positive tube, while soda, ammonia, and lime passed over into the water, the barytes after some time, passed over likewise.

The mode of this decomposition and transition, may be thus briefly explained. Hydrogen, alkaline substances, and certain metallic oxides are attracted by negatively electrified metallic substances, and repelled by positive ones. The contrary effects take place with oxygen and the acids. It would appear, that these electric energies are communicated from one particle to another of the same kind, so as to establish a conducting chain in the fluid, as acid matter is always found in the alkaline solutions through which it is transferred, as long as any acid matter remains at the original source. It is possible that there may be, in some cases, a succession of decompositions and recompositions, as in the decomposition of water and of solutions of neutral salts; especially as the formation of insoluble compounds, carrying them out of the sphere of electrical action, destroys the power of transference, in attempting to pass barytes through sulphuric acid, or muriatic acid through sulphate of silver. In like manner, it was found that neither magnesia nor the metallic oxides would pass through an intermediate vessel of water, but sunk to the bottom. In some experiments a small quantity of sulphuric acid appeared to pass through very weak solutions of barytes and strontites; but it was probably transferred through the thin stratum of pure water, where the solutions had been decomposed by the carbonic acid of the atmosphere; for on repeating these experiments, and taking care to agitate the solutions frequently, the sulphuric acid did not pass.

In the decomposition of water, particle of oxygen is attracted by the positive point, and at the same time, a particle of hydrogen is repelled by it: the opposite process takes place at the negative point, and in the middle point of the circuit, whether there be a series of decompositions and recompositions, or whether the particles from the extreme points only are active, there must be a new combination of the repelled substances. In the same manner as when two portions of a solution of muriate of soda are separated by water; muriatic acid is repelled from the negative side, and soda from the positive side, so that muriate of soda is composed in the middle vessel. These facts seem to invalidate the opinion of Mr. Ritter, and others, on the elementary nature of water. Mr. Ritter conceived, that he had procured oxygen only from water by making sulphuric acid the medium of communication at the negative point; but in this case sulphur was deposited, and the

oxygen from the acid, and the hydrogen from the water, recomposed water.

Although similar effects could not be produced, by silently passing a strong current of electricity from a large electrical machine, for four hours through a solution of sulphate of potash, yet by employing fine platina points of $\frac{1}{70}$ inch diameter, cemented in glass tubes, the experiment was successful. By the same means, sulphuric acid was transferred through moist asbestus into water, so that no doubt can arise, but that the principle of action is the same in common electricity, as in the Voltaic.

It was shewn by Bennet, that many bodies brought into contact, and then separated, exhibited opposite states of electricity. And Mr. Davy himself, had observed, that when acid and alkaline solutions were employed in alternation with plates of a single metal, the alkaline solutions received the electricity from the metal, and the acid transmitted it to the metal. These principles seem to bear an immediate reference to the general phenomena of the above decompositions and transferences In the simplest case of electrical action, the alkali receiving electricity from the metal, would, on being separated from it, appear positive, and of course be repelled by positively electrified surfaces, and attracted by negatively electrified surfaces : the acid on the other hand, acquiring the contrary electricity, following the contrary order.

A combination of twenty alternations of charcoal, water, and nitric acid, and another of charcoal, water, and solution of soda, exhibited a positive energy on the side of the alkali, and a negative energy on the side of the acid. Forty series of zinc, moistened pasteboard, and moistened quicklime, formed a weak pile, in which the lime acted like an alkali.

In attempting to ascertain the electrical states of single insulated acid and alkaline solutions, after their contact with metals, the results were rendered unsatisfactory by evaporation, chemical action, and the adherence of the solutions to the surface of the metals.

Insulated plates of copper, zinc, and tin, brought in contact with dry oxalic, benzoic, and boracic acid, and then separated, were found to be positive, and the acid was left negative. The insulation of the acid was of no consequence. Perfectly dry phosphoric acid produced the same effect on zinc ; but after a few minutes exposure to the atmosphere, the acid wholly lost this power.

When metallic plates were made to touch dry lime, strontites, or magnesia, the metal became very distinctly negative. In these experiments with the alkaline earths, they were carefully reduced to the temperature of the atmosphere ; for in other trials made when they were cooling after being ignited, they appeared strongly electrical, and rendered the conductors brought in contact with them positive.

The powerful attraction of the fixed alkalies for water, presented great obstacles to their being tried. With potash, these

obstacles were found to be insurmountable; and the experiment only succeeded once with soda.—The weather was peculiarly dry, and the soda had been cooled, after ignition, in a crucible inverted over quicksilver. It produced at first the same effect with a plate of zinc as lime, but in only two minutes no further result could be obtained.

As sulphur is easily excited by friction, or small changes in its temperature, it required great caution in making experiments on it. Insulated metallic plates brought in contact with unexcited sulphur became negative, and the sulphur was left positive. This took place even with lead, when its surface was newly polished; but tarnished lead, which was probably used by Mr. Wilke, becames positive, and left the sulphur negative. In the decomposition of sulphuric acid, mentioned above, the sulphur separates on the negative side. Sulphur examined immediately after being heated gave a positive charge to conductors; and a slight contact with a dry hand is sufficient to render it negative. It is likewise necessary, in these experiments upon contact, to take care that the metallic plate is free from electricity; as well polished plates of copper and zinc will receive a negative charge from being laid upon a mahogany table.

Concentrated solution of phosphoric acid is decomposed by Voltaic electricity, and the phosphorus which is separated forms a phosphuret with the negative wire. From analogy therefore, we may infer its electrical energy on the metals to be the same as that of sulphur. Experiments made on it, by contact, were unsuccessful, perhaps from its slow combustion.

The electrical energies of hydrogen and oxygen, in respect to metals, cannot be examined by contact; but that oxygen possesses the negative, and hydrogen the positive energy, is confirmed by the agency of their compounds. Thus, a solution of sulphuretted hydrogen acts in combinations of one metal and two fluids, in the same manner as solutions of alkali; and a solution of oxymuriatic acid is more powerful, in similar arrangements, than stronger solutions of muriatic acid. As to the solutions of hydroguretted sulphurets, they are more active than alkaline solutions; and particularly active with copper, silver, and lead. In a combination of copper, iron, and hydroguretted sulphuret of potash, the electricity did not circulate from the copper to the iron, and from the iron to the fluid, as in common cases; but from the copper to the hydroguretted sulphuret, and from that to the iron.

Bodies possessing opposite electrical energies, in regard to one and the same body, probably possess the same in regard to each other. Lime became positively electrical, by repeated contacts with crystals of oxalic acid; and these crystals, placed on a condensing electrometer, and repeatedly touched by the lime, which after each contact was freed from its charge, rendered the gold leaves negatively electrical. The tendency of the mere contact of the acid and the alkali with the metal, would be to produce opposite

effects, and therefore their mutual action must have been very energetic.

In the decompositions effected by electricity, the bodies appear incapable of combining, or of remaining in combination, when placed in a state of electricity different from their natural order. Thus, the acids in the positive part of the circuit separate from the alkalies, oxygen from hydrogen, &c.; and on the negative side, metals do not unite with oxygen, and acids do not remain in union with metallic oxides.

As the chemical attraction between two bodies seems to be destroyed, by giving one of them an electrical state different from that which it naturally possesses, so it may be increased, by increasing its natural energy. Thus, zinc is incapable of combining with oxygen when negatively electrified, although feebly; and silver easily unites with it, when positively electrified.

All substances that combine chemically, whose electrical energies are well known, exhibit opposite states; as, copper and zinc, gold and quicksilver, sulphur and the metals, the acid and alkaline substances; and therefore they ought to attract each other in consequence of their electrical powers. The relation, of course, between the electrical energy and chemical affinity is sufficiently evident: they may even be identical, and an essential property of matter.

The coated glass plates of Beccaria strongly adhere when oppositely charged, and retain their charges when separated. This fact affords a distinct analogy to the subject, and different particles in combining must still be supposed to preserve their respective states of energy.

In the simplest case of chemical union, two bodies in different electrical states, sufficiently exalted to overcome their power of aggregation, would unite into a combination more or less intense, as the energies were more or less perfectly balanced.

Different substances have different degrees of electrical energy in relation to the same body; as sulphuric acid is more powerful with lead than muriatic acid, and solution of potash is more active with tin than solution of soda. Such bodies may also be in the same state, or repellent with regard to each other, as in the cases just mentioned; or they may be neutral; or they may be in opposite or attracting states, as appears to be the condition of sulphur and the alkalies, although they have the same energy in respect to the metals. Hence, an easy explanation is afforded of the causes of elective attractions, and the decompositions that take place in consequence. In other cases, there may be such a balance of attractive and repellent powers, as to produce triple compounds, or even more complicated unions.

It will also be easy to explain the influence of the mass of bodies upon their affinities; for the combined effect of many particles, possessing a feeble electrical energy, may be conceived equal, or even superior to the effect of a few particles, possessing a strong

electrical energy; and accordingly we find, that concentrated alkalies resist the transmission of acids more powerfully than weak ones.

As the strength of the electricity diminishes from the points to the middle of the water, a measure of the artificial energies may be obtained, by observing the place where the compounds begin to be decomposed. Thus, sulphate of barytes requires immediate contact with the wire; and solution of sulphate of potash exhibited no sign of decomposition (with 150 pairs of plates and a circuit of water ten inches in length) at four inches from the positive point, but when placed within two inches it was slowly decomposed.

As heat and light are the consequences of a restoration of the equilibrium between bodies in a high state of opposite electricities, so are they also the result of all intense chemical action. And again, when large quantities of electricity of low intensity act, heat is produced without light; so in slow combinations, the temperature only is increased. The effect of heat in promoting chemical action seems not confined to the freedom of motion it gives to the particles, but to the exaltation of the electrical energies of bodies, such as is well known to take place in glass, the tourmalin, and sulphur. The electricities of an insulated plate of copper and a plate of sulphur were scarcely sensible at 56° Fahr. to the condensing electrometer; at 100° they affected the gold leaves, without condensation; they increased in a still higher ratio as the sulphur approached its melting point; and at a little above this point the substances rapidly combine, and evolve heat and light.

In general, when the different electrical energies are equally strong, the combination seems to be vivid, the heat and light intense, and the new compound is in a neutral state, as in combustion, and the union of the strong acids with the alkalies; but when only one energy is strong, the effect is less vivid, and the compound exhibits the excess of the stronger energy. This idea is confirmed, by no electrical charge being given to plates of copper and zinc, by nitrate or sulphate of potash, muriate of lime, or oxymuriate of potash; on the contrary, subcarbonate of soda, and borax, give a slight negative charge, and alum, and superphosphate of lime, a feeble positive charge.

The great tendency of the attraction of the different chemical agents, by the positive and negative surfaces in the Voltaic apparatus, seems to be, to restore the electrical equilibrium; and the phenomena seem to depend on the joint agency of the electrical energies and the chemical changes. In a pile of zinc, copper, and solution of muriate of soda, the plates are in opposite states of electricity; and in regard to such low electricities, the water is an insulating body. Of course, each plate produces an opposite electricity on the opposite plate; the intensity increasing with the number, and the quantity with the extent of the series. Upon connecting the extreme points, the opposite electricities tend to

produce an equilibrium, which would cause the motion to cease; but the fluid medium being composed of two elements possessing opposite electrical energies, the oxygen and the acid are attracted by the zinc, and the hydrogen and alkali by the copper. Hence, the balance of power is only momentary; for solution of zinc is formed, and hydrogen is disengaged, the negative energy of the copper, and the positive energy of the zinc, is again exerted, enfeebled only by the opposing energy of the soda in contact with the copper, and the process of electromotion continues as long as the chemical changes can be carried on. By this means, the theory of Volta is in some measure reconciled with the chemical theory of galvanism.

A combination of copper, zinc, and water free from air, exhibits no permanent electromotive power, as the water is not readily decomposed, and the equilibrium seems capable of being restored through it. Concentrated sulphuric acid is equally inefficient; for it has little action on zinc, and is not decomposed without a strong power. The effect of neutro-saline solutions diminish, when troughs are used, as their acid arranges itself on the side of the zinc plates, and their alkali on the other; but the energy may be restored, by agitating the fluids in the cells. Diluted acids are the most powerful, for they dissolve the zinc, and furnish a gaseous product to the negative surface, which is immediately disengaged.

As sensible heat appears, when an equilibrium is produced by small metallic surfaces in the Voltaic battery, the opposite states being exalted, so, if the decomposition of the chemical agents be essential to the balance of the opposed electricities, the decomposition of the saline solutions ought to be attended with an increase of temperature. To water electrified in the gold cones, by the power of 100 plates, a drop of a solution of sulphate of potash was added in the positive cone; potash immediately passed rapidly over, and in less than two minutes the water was in a state of ebullition. When a solution of nitrate of ammonia was employed, the water was evaporated in three or four minutes, with a kind of explosive noise; and inflammation took place. The pure acids or alkalies produced very little effect, although they are better conductors.

That chemical changes are not the primary causes in these effects is evident, from the electricity exhibited by the application of metallic substances to one another; the effect of which is most distinct in a dry atmosphere, in which the most oxidizable metals do not change. And the energy of the same metal, in contact with the same acid, varies according to its place in the Voltaic combination. Thus, in a combination of diluted nitric acid, zinc and copper, the zinc in contact with the acid is positive; but in a combination, where water is substituted for copper, the zinc is negative.

In mere cases of chemical change, no electricity is exhibited. It

could not be detected in the combustion of iron in oxygen gas, the deflagration of nitre and charcoal, the combination of sulphuric acid with potash, or the mixture and consequent liquefaction of the solid amalgams of lead and bismuth. Zinc brought in contact with quicksilver, and separated, becomes positive; but if an amalgam is formed, it gives no signs of electricity. When an effervescence takes place along with heat, the vessel indeed becomes negative, but this arises from evaporation, snd the change of capacity in consequence of the alteration in the volume of the bodies, or their states of existence, by heat, which is a continually operating source of electrical effects, and often interferes with the results of experiments on the contact of bodies, or their friction against each other.

In the experiments of Guyton de Morveau on the adhesion of metals to quicksilver, it is probable that their adhesion, from the difference of their electric states, must have operated as well as amalgamation. And it is worth examining how far cohesion in general is influenced or occasioned by this effect of the difference of the electrical energies of bodies.

These singular facts admit of some general applications; as for instance, to the analysis of animal and vegetable substances. Muscular fibre, being electrified for some time, became dry and hard, and it left on incineration no saline matter. Potash, soda, ammonia, lime, and oxide of iron, were collected on the negative side, and the sulphuric, nitric, muriatic, phosphoric, and acetous acid, on the positive. Laurel leaf was rendered brown and parched; green colouring matter with resin, alkali, and lime appeared in the negative vessel, and prussic acid in the positive. The connection between the tubes being made by a healthy plant of mint, for ten minutes, potash and lime were found on one side, and on the other, an acid matter, that precipitated solutions of muriate of barytes, nitrate of silver, and muriate of lime. A long continuation of the process killed the plant.

The electrical powers of decomposition act also upon living animal systems; for when the fingers were placed in the positive part of the circuit, a mixture of muriatic, phosphoric, and sulphuric acid, is rapidly developed; and if they are placed in the negative part, fixed alkaline matter is evolved. The tastes observed in galvanic experiments seem to depend on the decomposition of the saline matters in the animal system. Now as acids and alkalies may be separated from living systems, there is reason to believe that they, or metallic oxides, may be introduced into those systems. Seeds placed in the positive part of the circuit germinated very rapidly, but in the negative not at all.

By using charcoal and plumbago, or charcoal and iron, as the exciting powers, along with neutro-saline solutions, large quantities of acids or alkalies might be procured, with little trouble or expense.

Ammonia and acids being decomposed only when in very con-

centrated solutions, and in other cases being merely carried to their points of rest, we may hope that this mode of analysis will lead us to the discovery of the true elements of bodies; for however strong the natural electrical energies of bodies may be, yet there is a probability of a limit to their strength.

It is also probable that the alterations of electrical equilibrium which are continually taking place in nature, considerably interfere with the chemica alterations in our system. Besides the electrical appearances which precede earthquakes and volcanic eruptions, there are tranquil alterations constantly operating. Electricity must be continually manifested where pyritous strata and those of coalblende occur, where the pure metals, the sulphurets, or any conducting substances, are found in contact with each other, and also where the different strata contain different saline matters; so that many mineral formations are probably owing to electrical agency.

A mixed solution of the muriates of iron, copper, tin, and cobalt, being positive, and water negative, all the oxides passed along the asbestus, a yellow metallic crust was formed on the negative wire, and the oxides arranged themselves, in a mixed state, round its base. In another experiment, green crystals collected round a cube of zeolite, connected with the negative wire, and placed in water which contained carbonate of copper diffused through it.

Natural electricity has hitherto been only slightly investigated, except in its powerful concentration in the atmosphere; but its slow and silent operations in every part of the surface will probably be found more important.

Observations.—We have entered thus fully into the particulars of Mr. Davy's paper, because we think it one of the most interesting that has appeared for many years, either in the Philosophical Transactions, or in any other cotemporary publication. On such a communication we shall have little to remark, except in order to do justice to the merits of the author.

The general law, that those bodies which have powerful chemical affinities for each other, acquire, by simple contact, opposite states of electricity, and that this electrical affection is neutralized whenever a chemical action takes place, not only affords a satisfactory theory of all the known phenomena of galvanic electricity, and removes all the difficulties in which they have hitherto been involved, but also enlarges very considerably our views of the nature of chemical action in general. With respect to this law, Mr. Davy's claim to complete originality is indisputable: the other facts which he has established are perhaps equally important, but they must have arisen more naturally out of a careful repetition and a judicious extension of the experiments of Volta, Pacchioni, Brugnatelli, and some other philosophers, both in this country and in Sweden. Still, however, to account satisfactorily for the ap-

pearance of all the products which have insinuated themselves, as if by magic, into places where they never could have been expected, from the time of the discovery of the apparent separation of hydrogen and oxygen, to that of the supposed generation of the muriatic acid; and to shew the nature of those powers which carry the substances, thus violently detached from their nearest connections, through paths so apparently impassible, in spite of the strong attractions of the various obstacles with which those paths are beset, to the place of their destination;—all this must be allowed to have required no small share of industry and ingenuity. On the continent, the majority of philosophers have hitherto been inclined to adopt the hypothesis of Volta, respecting the mechanical or purely electrical origin of galvanic phenomena. In this country, many have been induced to agree with Dr. Wollaston, in considering a chemical change as the general cause of all electrical appearances. Mr. Davy has now shewn how far both these opinions are admissible, and that the facts on which they are respectively founded may be reconciled with each other, by means of the theory which he has proposed. That the chemical affinities of bodies could in some measure be overcome by artificial electricity, was already established in particular cases; but it was never suspected that this effect was produced by an alteration of the circumstances on which those affinities originally depended. Mr. Davy has not only explained these electrical decompositions, but has shewn that they probably act a very important part in the natural transformations of the mineral kingdom; and has hinted that they may be employed with advantage in the service of practical chemistry.

If there is any part of Mr. Davy's reasoning to which we may be allowed to object, it is that which relates to Mr. Morveau's experiments on attraction, and to the nature of cohesion. The attraction which is exhibited in such experiments, as well as in the phenomena of capillary tubes, cannot, with a shadow of probability, be supposed to depend on the different electrical properties of the substances concerned; since these effects are exhibited in their greatest extent, between substances which, as far as we can judge, are perfectly homogeneous, or between different parts of the same substance, and cannot therefore be in any degree influenced by the mutual relations of heterogeneous bodies.

If the adjudgment of the ample prize allotted by Bonaparte to the author of any discovery relating to galvanism, which may constitute an era in the science, of equal importance with the discoveries of Franklin and Volta, were intrusted to a tribunal perfectly impartial, and equally selected from the learned of all nations, we have scarcely a doubt that Mr. Davy would be considered by a great majority of the judges as fairly entitled to this remuneration. At present however there is little reason to expect that national prejudice will be so far subdued, as to allow so substantial a testimonial of esteem to be conferred on a foreigner; that foreigner being also an Englishman; and Mr. Davy must be con-

tented with the applauses of his countrymen, and the approbation of the candid and liberal of all other nations. A tribute of respect has indeed already been paid to him on this occasion, by the author of a late splendid work, in which the apparatus employed in these experiments, is placed, as a new constellation, between Pegasus and the Eagle. We sincerely hope that this distinction will be at least as long remembered as the mark of adulation which the University of Leipzig is said to have shewn to the great conqueror of the continent, by assigning to the belt of Orion the denomination of "The stars of Napoleon."

Experiment made by the Galvanic Society, on the Formation of Oxygenized Muriatic Acid, and the Separation of Soda from Muriate of Soda, by the Pile. By Mr. CHOMPRE.—*Ann. de Chim.* No. 181.

THE slight traces of muriatic acid obtained in galvanic experiments, on the decomposition of water, led to the employment of a solution of muriate of soda in the tubes containing the water to be decomposed.

Mr. Pacchioni, in a letter to a member, said, that, on employing a solution of muriate of soda, in the tube connected with the negative wire, he found that tube after the experiment, to contain only a solution of soda, without any trace of muriatic acid. The society repeated this experiment with success; but the water in the positive tube was not examined.

With a view of more accurately determining what passed in this experiment, a committee of the society made the experiment on a larger scale. 100 grammes of muriate of soda were dissolved in 400 of water, and 50 grammes (770 grains Eng.) of this solution were put into a tube connected with the negative end of the pile, by a gold wire. About the same quantity of distilled water was poured into another tube, connected with the other end of the pile. As the first was wider, and of course shorter, it was kept up by a cylindrical tin supporter. The communication between the water in the two tubes, was made by means of a syphon, previously filled with water. This apparatus was fixed in a glass plate, standing on an earthen dish, and the whole covered with a bell glass. A pile in three columns of 100 discs in the whole was used; this pile was renewed at the end of 60 hours, and the experiment continued for 36 hours longer. At the end of that time, the pile was withdrawn, and the remainder of the apparatus was left untouched for eight days.

During the experiment, the solution of muriate of soda became covered with a scum; a whitish pellicle covered the sides of the tube, and descended as far as the glass tube was exserted out of the tin tube. The solution was slightly turbid. After the pile had been removed, the semi-opake pellicle spread upwards to the lower

part of that branch of the syphon. The muriate was found not to be completely decomposed, as the taste of the muriate of soda was still perceptible; but it rendered syrup of violets green, and flung down a milky precipitate from muriate of lime. From the pellicle not descending below the level of the tin-case in which the glass tube was supported, it was inferred that light has some influence in this case.

The water in the other tube soon became greenish yellow, and the wire was corroded, so that when the experiment was finished the end of it had actually been entirely dissolved. A strong smell of oxygenized muriatic acid was evident, when the bell glass was taken off. The water in this tube destroyed the colour of tincture of litmus. It yielded a very copious and dense precipitate, with muriate [nitrate ?]of silver, and communicated a deep purple colour to a slip of tin foil. A white sediment was found at the bottom of the tube, which soon became black by the contact of the air, being the muriate originating from the silver with which the gold wire was alloyed.

Mr. Chompré repeated the experiment, using platina wires, and putting the muriate of soda into the positive tube. He found the water in this tube still transparent, but impregnated with muriatic acid; that in the negative tube was alkaline.

In another experiment, both tubes were filled with a solution of muriate of soda. The platina wires were slightly oxidized, and the positive tube contained muriatic acid, whereas the negative tube, which in all cases yielded the most gas, contained an alkali.

Mr. Riffault varied the experiment, by putting a solution of nitrate of soda into the negative tube, and water only in the other; no gas was emitted from the nitrate, and the effect of the pile was very slight. But on changing the wires, so as to make the water communicate with the negative end of the pile, and the nitrate with the other, the effect became greater, and considerable currents of bubbles of gas were disengaged from both wires for the whole time of the experiment, although it lasted near 200 hours. He also tried nitrate of soda in both tubes, the result of which he will hereafter communicate.

Facts relative to the History of Cobalt and of Nickel. By Mr. Proust.—*Journ. de Phys. Dec.* 1806.

Sulphuric, muriatic and nitric acid all oxidize cobalt in the same manner: the two first yield hydrogen.

The sulphate of cobalt is of a rather sharp, bitter and metallic taste. Its crystals are small, octaedral, and red. They are not altered by the air, but lose 42 per cent. of water by distillation; they are then rose-coloured, opake, and will bear a red heat without decomposition, except where they touch the vessel.

Sulphate of potash added to this salt produces small rhomboidal crystals of a triple salt which is less soluble, and loses only 26 per cent. of water by distillation.

Carbonate of potash decomposes the simple sulphate, and throws down 40 or 42 per cent. of carbonate of cobalt, which is re-dissoluble by an excess of the precipitant. Boiling, or the addition of cold water decomposes this solution. This carbonate heated gradually in a retort filled as full as possible, yields 60 or 62 per cent. of a greenish gray oxide, which does not yield any oxygen when treated with muriatic acid. This oxide also dissolves in nitric acid without yielding any nitrous gas. Heated in contact with the air it immediately becomes black. The gray oxide ad minimum is soluble in weak acids, and may be thus separated from the other; or by ammonia.

Nitrate of cobalt dropped into boiling water slightly alkalized with potash, lets fall a blue precipitate, which, if the boiling be continued, is changed into a rose coloured hydrate. If the alkaline water be cold, the blue precipitate is formed, but it becomes grass green, and preserves that colour after being dried. This green precipitate boiled, while fresh, in alkaline water becomes rose gray; Mr. P. supposes the precipitate when green, is a combination of the blue and black oxide, and when rose gray is a mixture of the hydrate and black oxide. The green oxide is not soluble in acids, nor does it form any saline composition.

The gray oxide communicates, in close vessels, only a slight rose colour to ammonia, but in open vessels it slowly dissolves; this solution may be hastened by throwing into the vessel a stream of carbonic acid gas. At first a solution of oxide of cobalt in carbonate of ammonia takes place, but if more carbonic acid is added than is necessary for the saturation of the ammonia, then the solution is that of carbonate of cobalt in carbonate of ammonia. When kept in close vessels, crystals of carbonate of cobalt are deposited: they may also be partly separated by the addition of water; carbonate of ammonia being added re-dissolves this precipitate. This salt may be obtained more readily by adding carbonate of cobalt to carbonate of ammonia.

Ammonia added to carbonate of cobalt divides it into two parts, a hydrate is precipitated, and the remaining carbonate dissolves in the ammonia, which is become a carbonate by abstracting the acid from the precipitated portion.

Ammonia also forms in close vessels a red solution with the hydrate. If this solution is slowly poured into boiling water, it lets fall blue oxide; but if poured into cold water, a green oxide is obtained.

The ammoniacal solutions being distilled, yield carbonate of ammonia; a dirty green oxide is deposited, which afterwards becomes black. This oxide is a mixture of the gray and black oxide, which are separable by acids.

Crystallized sulphate of cobalt, or nitrate, are decomposed by

liquid potash in close vessels, a blue precipitate falls down, which changes to violet, and at last to the rose-coloured hydrate. The hydrate boiled with potash yields a blue solution, which is decomposed by water, or by air; a black oxide being deposited. The hydrate is soluble in carbonate of potash, the solution is red; the oxide is not soluble. The hydrate is also soluble in acids with heat and effervescence. It is not decomposed by boiling either in water, or a weak alkaline ley; but it loses 20 or 21 per cent. of water by heat, and leaves a very pure gray oxide. The hydrate kept under water in open vessels becomes black: the dry hydrate absorbs carbonic acid.

Crystallized sulphate is also decomposed in close vessels by ammonia, a blue precipitate falls, which does not become rose coloured. Mr. P. thinks hydrate is formed, but that it is dissolved by the ammonia.

The gray oxide contains 19 of oxygen to the 100 of cobalt.

On distilling nitric solution of cobalt, nitrous gas is emitted, and the black oxide of cobalt is left, which weighs about 25 per cent. more than the cobalt originally dissolved. This black oxide can only be dissolved in nitric or sulphuric acid, by losing the excess of oxygen, and becoming the oxide ad minimum. It yields oxygen gas by solution in muriatic acid. It is insoluble in ammonia or potash. It changes into the gray oxide by exposure to a strong heat, and it colours glasses blue; but when mixed with oxide of manganese it is used in enamelling to imitate the tints of Indian ink.

Mess. Proust and Thalaker have found the black oxide at Pavias, a day's journey from Valentia. It is a constituent part of the vitreous, and black ores of cobalt.

The carbonate and hydrate of cobalt and the gray oxide are changed into black oxide by oxygenized muriatic acid. The nitrous and sulphurous acids dissolve the black oxide, but form nitrate and sulphate adminimum.

The gray oxide dissolves in muriaitic acid of 15°. forming a deep blue solution, which easily crystallizes, the crystals being blue. This is the arid muriate; as soon as it absorbs water, it becomes red. The same strong acid forms a solution of the black oxide, which is green as long as it contains the gas which is emitted in great quantity, but becomes blue at last.

The blue colour produced by muriate of cobalt used as sympathetic ink, is owing to the arid muriate; the green colour is owing to the mixture of muriate of nickel, which is itself yellow.

The muriate of cobalt when distilled is decomposed only where it touches the vessel, and thus yields muriatic acid along with oxygen, the vessel is tinged blue. The remaining muriate melts and is sublimed in linseed-gray flowers, which requires at least 12 hours to be dissolved in water.

A diluted solution of cobalt poured into a solution of arsenite of

potash, lets fall a rose-coloured arsenite of cobalt, which may be decomposed by heat, the oxide of arsenic flying off. This arsenite is soluble in nitric acid and yields nitrous gas. Its solution in muriatic acid lets fall orpiment by the addition of sulphuretted hydrogen. It is decomposed by potash, with heat, the blue oxide being separated.

If the dissolved cobalt is poured into the arseniate of potash, a rose-coloured arseniate of cobalt falls down. This does not yield any sublimate by heat, but becomes violet. It does not yield nitrous gas when dissolved in nitrous acid. Its solution in muriatic acid is not rendered turbid by sulphuretted hydrogen until more than two hours after the mixture. Potash separates the blue oxide. The rose-coloured efflorescences upon cobalt ores are arseniates; as the arsenite has only been found in the interior part of some specimens.

Sulphuretted hydrogen is taken from water by the gray oxide, the hydrate, and the carbonate of cobalt, and yields hydrosulphuretted oxide, which is not soluble in ammonia. It yields water and sulphurous acid by distillation, the residuum is the sulphuret of cobalt.

Oxides of cobalt heated with sulphur, produce sulphurets; 100 of cobalt absorbs about 40 of sulphur.

ON NICKEL.

One hundred parts of nickel heated with nitric acid, produce 125 or 126 of greenish gray oxide ad minimum; this is not reducible to an oxide ad maximum by further treatment with nitric acid. If oxide of nickel contains cobalt, it yields oxygenized muriatic acid gas by solution in muriatic acid, but not if it be pure. The gray oxide dissolves in all the acids, and yields solutions like those of the metal itself.

Dry nitrate of nickel distilled, yields 20 per cent. of water, 25 of oxide, and 55 of acid. If the distillation is carried only to a certain point, 142 parts of nitrate with excess of base may be obtained from 100 of nickel, so that it contains 17 of acid.

Muriate of nickel is only a granular concretion, apple green, and very deliquescent, when wrote with on paper, the strokes are yellow when dry. It loses by heat 55 per cent. of water, and leaves a yellow arid muriate which absorbs water from the air and becomes green. This arid muriate does not melt, the parts that touch the vessel in which it is distilled are decomposed, and yield simple and oxygenized muriatic acid: the remainder is sublimed in golden yellow pearl-like flowers, which in a couple of days absorb moisture and become green, they are difficultly soluble in muriatic acid. The muriate of nickel precipitated by carbonate of potash yields 61 or 62 per cent. of carbonate.

There are two sulphates of nickel, the simple sulphate, and

the triple sulphate with potash. Both are emerald green, transparent, and not altered by the air. The simple sulphate crystallizes in hexaedral prisms terminated by an irregular pyramid. It loses by heat 46 per cent. of water, the residuum again becomes green by absorbing moisture. By being heated to redness for an hour, part is reduced to a sulphate with excess of base; water separates the part which did not lose its acid. It yields 64 per cent. of pale green carbonate by precipitation. The sulphate of nickel-and-potash crystallises in rhomboids. It loses by heat 24 per cent. of water; the residuum resembles that of the simple sulphate. By precipitation it affords only 27 or 28 per cent. of carbonate. It is probable that the relative proportion of the nickel and potash are constantly the same in this salt.

In extracting nickel or cobalt from its ores, if we have a solution of the ore, first calcined, and afterwards vitriolized with the residuums of ether, the nickel must then be separated from iron, copper, arsenic, bismuth, and cobalt The iron is oxygenized ad maximum, and having in that state but a slight attraction for acids it may be precipitated in the form of an arseniate by adding successive portions of potash, until ammonia, or a prussiate shows that it is got rid of; sulphuretted hydrogen passed through the supernatant solution will throw down the copper, bismuth, and arsenic in combination with sulphur. The supernatant fluid being then separated, and crystallised; the sulphate of nickel-and-potash being less soluble than the sulphate of cobalt-and-potash may thus be separated, the last portions of the latter may be separated from the former salt, by washing its crystals with cold water.

A salt of nickel is pure when the precipitate dissolved in ammonia leaves that solvent without any signs of cobalt. Potash must not be spared in precipitating the sulphate of nickel, for fear the sulphate with excess of base should be formed, and thus render the precipitate impure.

Carbonate of nickel yields in close vessels 54 or 55 per cent. of greenish gray oxide ad minimum; in open vessels the oxide is black. The oxide ad minimum attrates carbonic acid from the atmosphere.

All salts of nickel flung into boiling ley of potash are changed into green hydrate, the colour of which is not altered by boiling; but on being heated it is changed to gray oxide. It is the hydrate of nickel that forms the basis of the salts of that metal, as alkalies precipitate it in that state. It is not soluble in potash, any more than the oxide.

The carbonate and hydrate of nickel are changed into oxide ad maximum by exposure to oxygenized muriatic acid; the gray oxide is more difficult to be changed. The oxide ad maximum when dry is black, and when solid, has a vitreous fracture; treated with ammonia, it emits bubbles, changes into gray oxide, and is then dissolved. Treated with muriatic acid at 15°. Beaume, it yields a quantity of oxygenized muriatic acid, and forms a greenish yellow solution which crystallises on cooling.

The oxides of nickel are easily reduced, and yield a well shaped button, whereas those of cobalt yield only detached grains.

100 parts of nickel, combine with about 46 of sulphur.

The arseniate and arsenite of nickel may be procured in the same manner as those of cobalt; they are both of a fine apple green.

The arsenite being heated in close vessels, loses its colour along with the water it contains; it throws out fumes of white oxide of arsenic, and becomes of an olive green. The addition of charcoal is necessary to separate all the arsenic; when heated from below in a platina spoon, the arsenic is speedily got rid of, and oxide ad minimum is left.

The arseniate in close vessels also loses its colour along with the water, it becomes transparent, and of a hyacinth colour; by a red heat, this is changed to a pale yellow, which undergoes no further alteration. In the platina spoon, it becomes white, and may be heated to redness without melting or throwing out the least arsenical fume; it is only the dark flame that can decompose it.

Hence Mr. P. concludes that cobalt and nickel, like most other metals form only two oxides: in only two metals, viz. tin and lead has he hitherto found more. The quantity of oxygen in the oxide of tin that forms the basis of aurum mosaicum, and in the oxide of lead that forms the basis of the salt made by boiling the nitrate of lead upon plates of that metal, is unknown.

It is probable that the two oxides may combine together and produce intermediate oxides. Thus the green oxide of cobalt is a combination of the blue and black oxide; and minium is perhaps a combination of the brown oxide of lead, with that containing 9 of oxygen, to the 100 of lead. Many iron ores appear to be similar combinations, for if it was not so, what hinders the oxide from attaining its maximum. The oxide of iron that lines the tube through which steam has been passed is formed of the two oxides of iron.

Observations.—We must confess that there are one or two passages in this paper that we do not perfectly understand, arising no doubt from the defects of Mr. Proust's style, for all his papers as published in the French journals, are no less remarkable for the diffuse style in which they are written, and the gross solecisms and uncouth expressions with which they abound, than they are for the numerous facts that they contain. It is a pity that as Mr. P. has evidently such difficulty in expressing his thoughts properly in the French language, that he does not employ some well educated native of that country to revise his writings, and thus give the necessary polish to such excellent papers, that present a striking contrast to the general run of the memoirs of the French chemists, since those are, in general, barren of facts, and filled only with crude hypothesis, or the most arrant misrepresentations of the labours of others.

On the Formation of Acetous Acid during Indigestion. By Mr. PERPERES.—*Ann. de Chim.* No. 180.

IT had been already stated that acetous acid was formed in the stomach, and that fermentation was necessary to digestion; but the true nature of that process had never been ascertained.

Mr. P. finding that roasted chesnuts were not digestible by his stomach, and that they produced wind, followed by a sourness of the stomach, eat eight ounces of them without any bread, having previously emptied his stomach by fasting 13 hours. In an hour and a half he discharged about a cubic inch of gas, which was found to be carbonic acid gas mixed with a little atmospheric air.

The swelling of the stomach having diminished, and the sourness taking place, he took 20 grains of ipecacuanha in 3 oz. of warm distilled water, and in a quarter of an hour he drank 14 oz. of warm distilled water without effect; but on drinking 3 oz. more water, he flung up all he had eat and drank, except 2 oz. which had either been digested or absorbed by the stomach.

The matter flung up resembled starch diffused in water, it had a sour smell, and tinged both litmus paper and infusion of violets red. By distillation in a retort it yielded 16½ oz. of a very white liquor which strongly resembled distilled vinegar, and a little carbonic acid gas. This liquor was saturated with soda and crystallized, the crystals perfectly resembled acetate of soda, both in physical and chemical qualities.

Hence it appears, that the swelling of the stomach in indigestion is occasioned by the formation of carbonic acid gas, arising from the incipient decomposition of the substances just eaten, that the sourness arises from the formation of acetous acid, in consequence of the complete disorganization of the aliment. It appears also that 8 oz. of roasted chesnuts will produce 2¾ oz of acetous acid, by being fermented for an hour and a half in the stomach.

The best remedy for this weakness of digestion is, to take after eating, 10 grains of columbo root, with 12 gr. of calcined magnesia, in a single dose.

Observations on a new Species of Stone, called by HAUY, *Diopside. By* MR. TONNELLIER.—*Journ. des Mines.*—No. 115.

THIS species includes the mussite and alalite of Bonvoisin.

Its specific gravity is 3.2374. It does not scratch glass, or very slightly. It scratches fluate of lime. It is fusible by the blow-pipe into a grayish glass. Its primitive form is a rectangular quadrangular prism, with oblique bases, in which the incidence of the diagonal of the base upon the lowest edge of the prism, is 107°. 8′. The

prism is divisible, with very neat surfaces in the direction of both the diagonals of the bases. The divisions parallel to the bases are in general very neat, those parallel to the sides are less easily obtained.

Its place in the system of Hauy is immediately after pyroxene, the primitive form being, in some measure, analogous; that of the present species differs however from the primitive form of any other; and gives the name of diopside (double view) to the species, from the two different aspects it exhibits, first by its prism, which is a rectangular quadrangle, and secondly by its bases, which are rhombs inclined on the planes of the prism.

Its determinable forms are:

1. *D. primitif.* A variety of mussite. The joints which appear on breaking these crystals must not be confounded with the natural bases.

2. *D. didodécaèdre.* A prism of 12 sides, terminated at each end by six faces, situated by two and two, one above the other. It is analogous to what was stated by Bonvoisin, as the regular crystallization of alalite: but he only used the goniometer to state the inclination of the planes.

Its indeterminable forms are:

3. *D. comprimé et laminiforme.* This compressed variety was found by Mr. Tondi, arranged with specimens of another species. It is a mussite.

4. *D. cylindroide.* In prisms charged with grooves.

5. *D. compacte.* This serves as a gangue to the crystals of mussite, and was rightly conjectured by Mr. Bonvoisin to be the same substance.

As to colour it is green, greenish gray, greenish white, and yellowish white.

As to transparency, it is either translucid or opake.

The topazolites of Mr. Bonvoisin, are hyacinth red garnets, of the variety called by Hauy *grenat emarginé.*

The pyrophysalite of Hisinger and Berzelius is a greenish white, almost opake variety of aluminous fluate of silica, or topaz.

Observations.—Mr. Bonvoisin's description of the mussite, alalite, and topazolite, may be found in vol. i. p. 353; and that of the pyrophysalite, by Hisinger and Berzelius, in vol. ii. p. 457.

On the Employment of Mineral Coal in smelting Iron, after the Catalan Method.—By Mr. Muthuon.—*Journ. des Mines*, No. 115.

Carbone is certainly a simple body, but charcoal and coke are not pure carbone; the first contains potash and ashes, the second contains ashes, a little potash, compound salts, earth, and metallic particles. Carbone serves to disengage caloric, to dis-oxidize the iron,

and to concur in the formation of steel; but on account of their respective residuums, the use of charcoal or coke is attended with different effects. Even the wood of which the charcoal is made has its effect: thus, chesnutcharcoal renders iron soft, because it contains but little carbone, and much potash and ashes, which are excellent fluxes.

The residuum of coke being much inclined to scorification, attacks the iron and alters its quality. It also attacks the furnace, so that the fire-place ought to be made of granite, or of a refractory lining. The forges usually employed in the Catalan method of procuring malleable iron from the ore, by a single operation, are made of cast-iron plates, or of iron bands, so that not only the fire-place is heated in one or two firings, and must be cooled occasionally, but nearly as much iron is manufactured at the beginning of the week as at the end, and the stoppage every eight days, or even oftener, produces little inconvenience.

When the apparatus is duly proportioned to the forge, and properly arranged, five or six firings may be given in 24 hours, and a much larger quantity of ore may be reduced in a given time than in the contrary case. The size of the fire-place is not determined. In Spain there are some that manufacture five tons of iron per week. Some are one-third larger than others that use the same ore. At Loubie-Loubiron, near Pau, the forges and apparatus are so small, that they are contained in little huts, of about three metres (9 feet) cube.

The wind ought to be increased gradually from the commencement to the end of the operation; nevertheless it is proper to remit the wind at the time the *eye* of the furnace is pierced. It is peculiar to the Catalan method to plunge the twyer, during the greater part of the firing, into the matter in fusion. This important observation has hitherto been neglected by metallurgists.

Observations.—The use of the Catalan method is rapidly extending itself over the continent, on account of its abridging the workmanship, and diminishing the consumption of fuel; to which may be added the smallness of the capital it requires.

Observations on the Crystallized Bodies inclosed in Lava.—By Mr. G. A. Deluc.—*Journ. des Mines*, No. 115.

Mr Fleurian de Bellevue supposed that the crystals found in lava, were formed from the mass of the lava by slow cooling; and that they were analogous to the formation of crystallites in glass.

Crystallites however differ only in their appearance from the remaining part of the glass; but the crystals found in lava, are perfectly distinct from the mass of the stone, and the lavas that contain leucite (white garnet), frequently contain also augite (volcanic schorl, or pyroxene), and olivine, or chrysolite; all of

which are perfectly distinct from one another, as well as from the lava in which they are inclosed.

The summit of the crater of Etna is covered with schorls mixed with scoriæ; the schorls in the interior of the crater exhibit their natural polish, those that are on the exterior have a crust of lava; so that the acid vapours of the volcano have dissolved and cleared the surface of the schorls.

Leucite has been found traversed by schorl, and then imbedded in lava; here then it appears, that the schorl has been formed first, and afterwards the leucite.

The lava of Etna does not contain any leucite, and on the other hand, the lava of Vesuvius does not contain any of the whitish crystalline laminæ so frequent in the lava of Etna, although the other contents of the lava are similar. The lava of Hecla does not contain any of the crystallized bodies found in the Italian lava, but a great quantity of small white broken crystalline bodies, from the size of hemp seed to that of peas, which appear to be fragments of quartz. The lava of the Mont d'Or, in Auvergne, contains large crystals of amphibole (hornblende), and of felspar; both of these bodies appear, by their cracks and tarnished surfaces, to have been affected by the heated lava. In other lava of Auvergne pyroxene is found without leucite. Hence, it appears that a difference exists in lava which depends upon the strata which inclose the seat of the fire.

That slow cooling is not necessary for the production of pyroxene, is evident from their existence in the stalactites of lava that have been formed in an eruption of Vesuvius in 1754, as the small jets of very liquid lava, which must have formed the stalactites, were doutless hardened in a moment.

The heads of the current of lava break, and the fragments are pushed forward by the impulse of the posterior part of the lava: yet in these fragments, although they remain a long time ignited, pyroxenes are found.

Leucite is easily altered by the action of fire, and volcanic vapours, but it still retains its shape, although it becomes cracked, and the cracks are filled with lava, as at Viterbo.

So far from these crystalline bodies being formed in the crater, no example can be found of any other than sublimates of salts, and sulphur. The insulated crystals found on the cones of volcanoes, were separated from the sides of their internal parts, by the ebullition of the lava. Thus, the crater of Etna, formed in 1692, is covered with pyroxene coated with lava, and also incloses, as has been said, small crystalline plates, which from their irregular figure, have every appearance of being the fragments of a rock that has been split in pieces by the heat.

The *play of affinities*, to which the formation of these crystalline bodies has been ascribed, can scarcely take place in the thick and only half-melted state in which lava is generally protruded.

The principal seat of the fires of volcanoes is, no doubt, much

deeper than the base of the cone, in which it has been placed by some; but still it is not so deep as others have supposed. The burning places appearing under the neighbouring sea during eruptions, shew that it is not deeper than a league or so, and that it branches along galleries, from whence the stones ejected by the volcano are carried off. The fires in the larger volcanoes, as at Etna, Teneriffe, and Peru, are probably deeper than those of the smaller, as Vesuvius, Vulcano, and Stromboli.

The productions of our artificial fires are very different from those of volcanoes. Mr. Fl. de Bellevue, indeed, has adduced an instance in which he supposed, that a product, resembling certain roches cornéennes of the Alps, or some compact homogeneous lavas, had been formed during the burning of a specimen of lime-stone; but it is far more probable that a fragment of some other stone was imbedded in this lime-stone, which is a very common occurrence.

The fires of volcanoes are not sufficiently powerful to melt the surrounding strata; besides the gaseous products, sulphur is the principal ejection, with some iron, muriatic acid, and sal ammoniac. The neighbourhood of the sea seems essential to their action, for they are never found at a distance from it, and during an eruption of Vesuvius, a crevice in its crater has been observed, lined 2 or 3 inches thick of common salt. Humboldt and Bonplan, indeed, mention the sudden appearance of a volcano in Mexico, in 1759, at 40 leagues distance from the sea, but it is probable, that in this single instance, there was some subterranean communication with the ocean.

The extent of the fire of volcanoes, the noise that accompanies it, and the immense currents of lava, lead common observers to suppose that it is very intense; but when we consider the want of a current of air, we shall soon perceive that it is far from equalling the fire of our furnaces; and, indeed, we find that the generality of lava is not perfectly vitrified, and pyroxene is vitrified in our furnaces, although it is not altered by the fire of volcanoes. The obsidian, or volcanic glass, having undergone a more complete fusion, contains no crystalline substances; notwithstanding it no doubt cooled as slowly as the other ejections.

Mr. Faujas is said to have possessed a piece of palm-tree imbedded in lava. Some Danish travellers are said to have seen wood imbedded in the lava of Hecla, and Count De Borch professes to have seen wood slightly roasted in the lava of Etna; but these appear to be mere deceitful appearances, as several specimens of a similar kind, which were only fibrous varieties of lava, have been mistaken by many persons for wood.

Lava when ejected from volcanoes is not as liquid as water, although it has been compared to it, and it has been stated as impossible for the crystalline bodies to have been immerged in it at that time, but in the great eruption of Etna, in 1669, innumerable crystals of pyroxene were ejected with violence from the

crater, and therefore, those now found in the lava that issued from the base of the volcano, may reasonably be supposed to have been contained in it at the moment of its eruption. Neither volcanic fire, nor our furnaces, afford products similar to the primitive rocks, which are all of aqueous formation. That the sea does not continue to form these rocks, is owing to its being despoiled of the elements necessary to their formation. The mud of rivers does not reach the bottom of the sea, being pushed back by the waves, and this increase of the shore has been frequently mistaken for a decrease of the sea, whose level does not, in fact, seem to be affected by these petty operations.

Volcanic mountains are by no means so common as many have supposed; even in Italy they are confined to the west side of it, and separated by strata of aqueous formation. It is highly improper to say that volcanoes are found on the summit of a mountain, since it is the mountain that constitutes the volcano, so that the fire frequently breaks out on the sides or even at the base.

All the volcanic mountains in the middle of the continent were originally submarine; the slates and granite that surround some of them are foreign strata, through which their eruptions have forced their way. Count Marzari de Vicentia found at Santourgue, a stratum of volcanic sand between two strata of lime-stone, so that an eruption having ejected this sand to the thickness of six inches, upon a bed of lime-stone that had been deposited on the sides of the then sub-marine volcano, the sand was afterwards covered with a fresh stratum of lime-stone; an operation which could only take place under the sea.

In order to distinguish the age of volcanoes, we might call those, ancient, that burned under these a before our continents were dry; and those that might still burn, if their inflammable materials were not exhausted, by the name of extinguished volcanoes.

Observations.—Professor Jameson considers the discovery in Hungary, of pumice alternating with porphyry, as a proof that pumice is of aqueous formation, but this is far better accounted for on the hypothesis of Mr. Deluc, of its being produced by a sub-marine volcano, and then covered with a fresh deposition of porphyry, in the same manner as the volcanic sand mentioned by Count Marzari de Vicentia was covered with a bed of lime-stone.

Observations on certain Aftercrystals in the Collection of the Conseil des Mines. By Mr. Tonnellier.—*Journ. des Mines*, No. 116.

There are many aftercrystals of steatite from Bareuth, in the collection of the *Conseil des Mines*, resembling several varieties of quartz and of carbonate of lime. A specimen of steatite, from Carlsbad, is in the form of that variety of felspar, which Hauy

calls *feldspath binaire:* it constitutes part of a rock with base of felspar.

A curious specimen of serpentine has been found in the Vallée de Viege, au Mont Rose, which is of a greenish colour, rather transparent on the edges, approaching to the *edler serpentine* of Werner, and containing specular iron ore, disseminated in it. This serpentine exhibits first, the form of *quartz hyalin prismé:* and, secondly, the same form, but in which planes are substituted for the edges contiguous to the summits of the pyramids. This substitution had not, when this specimen was first procured, been observed in quartz, but Mr. Hauy found by calculation, that it might be derived from the primitive form of quartz, and Mr. Tondi has since found it in some quartz crystals that lined the interior surface of a geode.

It was at first supposed, that these pseudomorphoses were formed by the influence which one part of the substance exerted upon the other, and thus forced the mixed mass in some measure, to assume its own particular form, as in the crystallized free-stone of Fontainbleau; but the crystals of steatite are perfectly similar to the rest of the mass, and do not shew the least appearance of any foreign substance. It is well known that quartz assumes the form of fluate of lime, carbonate of lime, and sulphate of barytes, and as these aftercrystals are found in the neighbourhood of their prototypes, there can be no doubt of their being deposits in the places formerly occupied by certain crystals of those prototypes.

The similiarity of the crystallized steatite with the rest of the mass, is unfavourable to the idea of its being a real crystallization of steatite, for when a substance is regularly formed in imbedded crystals, these crystals are usually different from the amorphous mass in which they lie. Thus the double pointed crystals of quartz are found in Parian marble, in some clays and marls, and in porphyry; those of *quartz hématoïdes,* and of borate of magnesia, (boracite) in gypsum: those of selenite in clay; and those of specular iron ore, garnet, turmalin, and magnesiferous carbonate of lime, in talcslate.

Although the primitive rhomboid of calcareous spar, might, and, indeed, does produce the same prismatic form as is exhibited by quartz, it cannot produce the hexaedral pyramid, which terminates the prisms of quartz, so as to have angles of the same value. Mr. Herricart-Thury, has found near Grenoble, calcareous spar in hexaedral prisms, terminated by pyramids of six triangular faces, but these crystals are different from those of quartz, as to the inclination of the planes, and the values of the angles, in the same manner as those of phosphate of lime, and phosphate of lead, both of which are sometimes found in a similar form.

The manner in which the quartz has been removed, so as to leave the hollow in which the steatite has afterwards been moulded, is however totally unknown at present.

Observations.—We have not the least doubt but that the crystals of steatite and serpentine here mentioned, were only aftercrystals, notwithstanding Prof. Jameson has considered them as real crystals, as we consider the arguments of Mr. Tonnellier perfectly conclusive. The removal of the quartz, which served for the type of the aftercrystal, is certainly not capable of being accounted for, in the present state of our knowledge.

Chemical Examination of the Alum Ore of Tolfa, and of the Earthy Aluminous Schistus of Freyenwalde. By Mr. KLAPROTH.—*Journ. des Mines,* No. 117.

THE alum mine of Tolfa, is the oldest in Europe. The ore is blasted by gun-powder, separated from the adhering rock, and calcined in kilns like those used for lime. The calcination lasts about six or seven hours; when it is friable it is laid up in heaps, and sprinkled for forty days with water. The water is then evaporated to a proper strength, and passed into trenches where it deposits large crystalline masses of alum.

About the beginning of the last century, an alum work was established at Freyenwalde in Brandeburgh. It belongs at present to the Orphan hospital of Potsdam, and makes yearly about 400 tons of alum. As the ore used here is soft, it is roasted, but left in heaps for a year or more exposed to the air. It is then elixiviated, until the ley is sufficiently strong, when the ley is boiled in leaden caldrons, till such time as it assumes on cooling the form of a crystalline mass of the consistence of honey. During this boiling of the ley, it deposits brown oxide of iron; the boiling ley is let out into troughs where it is left to become clear, and then let out into another trough, where it is mixed with the saline mass obtained by the soap-makers on boiling the residuary ley to dryness. The muriate of potash contained in this mass, is immediately decomposed, and the potash uniting with the sulphate of alumine forms perfect alum, which precipitates in small crystalline grains. The muriatic acid at the same time unites with the oxide of iron, and the muriate is retained in solution. The precipitated crystalline grains are washed with cold water, re-dissolved in boiling water, and slowly crystallized. Any other matter containing sulphate of potash might be used, such as the residuum obtained in making nitric acid, sandiver, &c.

The alum ore of Tolfa is found in irregular veins, or in lumps. That analysed was pearl gray, massive, dull with some brilliant specks; its fracture was unequal, approaching to scaly. It was a little translucid on the edges, hard, not adhering to the tongue, and heavy.

It lost $14\frac{1}{2}$ per cent. by distillation, and yielded water and sulphurous acid, but no sulphur. By a careful analysis, it was found to contain $56\frac{1}{2}$ per cent. of silica, 19 of alumine, $16\frac{1}{2}$ of sulphuric acid, 4 of potash, and 2 of water, 1 per cent. being

lost in the process. This nearly agrees with Vauquelin's statement.

The alum ore of Freyenwalde seems to be an altered brown coal. It forms a vast bed in alluvial earth. When fresh dug up it is brownish black, soft, glimmering but very feebly. Its fracture in the great is imperfect slaty; in the small, earthy. It has a waxy appearance when rubbed. It is a variety of Werner's alaunerde. It has usually been esteemed, as well as the argillaceous schistus, to be a clay impregnated with bitumen and pyrites. The schista indeed frequently contain pyrites, but these varieties yield a ferruginous alum, and are more proper for the manufacture of vitriol than alum. The ore of Freyenwalde does not contain pyrites, but its sulphur is combined with carbone.

The ore elixiviated with water yielded the sulphates of lime, and of iron. Another portion boiled in a solution of carbonate of soda, yielded a very deep blackish brown solution, from which the addition of muriatic acid, did not disengage any hepatic odour, but a blackish brown precipitate fell down, which burnt without any sulphurous smell. Muriatic acid had very little action on this ore, and no sulphuretted hydrogen was disengaged. 200 gr. dissolved in nitric acid, and precipitated by muriate of barytes, yield 54 of sulphate of barytes. 1002 grains of ore, fresh and still moist, yielded on distillation, 220 cub. in. of a mixture of sulphuretted hydrogen gas, and carburetted hydrogen gas, which burned with a blue flame, and left $\frac{1}{2}$ its bulk after being agitated with water. The liquid that passed over was watery, yellowish, and rendered turbid by light flakes of sulphuretted carbone. It smelled like sulphuretted ammonia, and being neutralized with muriatic acid, left 2 grains of muriate of ammonia. The black carbonaceous residuum weighed 750 grains and lost 90 by burning. The ashes yielded silica, alumine, lime, oxide of iron, and a trace of magnesia.

200 grains of the ore carefully distilled yielded $21\frac{1}{2}$ of water slightly impregnated with sulphuretted hydrogen. The residuum burned without flame or smoke, and with a slight sulphurous smell, by this operation it lost 45 grains, which were probably sulphur combined with carbone, and a little water that might remain from the distillation.

Hence this ore does not contain any bitumen, as it does not yield oil on distillation, and burns without smoke or flame. The sulphur which is oxygenized by exposure to air, and forms sulphuric acid, one of the elements of alum, is not contained in the ore in the state of pyrites, unless accidentally, but is united to carbone, by which it is protected from the action of alkalies, and does not yield sulphuretted hydrogen gas by treatment with muriatic acid.

As the sulphur was not separable from the carbone, the proportions can only be inferred from the quantity of sulphate of barytes precipitated from the nitric solution, compared with the loss on combustion. From whence it may be deduced that this

ore contains 28.5 per cent. of sulphur, 19. 65 of carbone, 16 of alumine, 40 of silica, 6. 4 of oxide of iron, 1. 8 of sulphate of iron, $1\frac{1}{2}$ of sulphate of lime, $\frac{1}{4}$ of magnesia, $1\frac{1}{2}$ of sulphate of potash, $\frac{1}{2}$ of muriate of potash, and $10\frac{3}{4}$ of water.

According to this, the ore with a proper proportion of potash ought to yield 21, 6 per cent. of alum; but a much less quantity only is extracted from it, owing to the imperfect efflorescence of the ore which is oxygenized only on the surface of the lumps, so that the greatest part of the ore remains unaltered.

The editor of the Journal des Mines remarks, that he has observed the coals, which disengage inflammable gas, not to contain any visible quantity of pyrites; and that other veins of coal which were full of pyrites, were worked without any danger.

On Meionite being considered as a Variety of Felspar, by Mr. Mohs. *By Mr.* Tonnellier.—*Journ. des Mines*, No. 117.

Hauy has dvided the species, hyacinth, of Romé De Lisle into four, viz. 1. zircon, 2. harmotome, 3. idocrase, 4. meionite, by which last name he designates what had been called by Romé De Lisle, white hyacinth of La Somme.

Werner considers this white hyacinth as a simple variety of felspar, and Mr. Mohs endeavoured in a paper inserted in Baron Moll's Ephemerides for 1806, to shew the truth of this opinion, by deducing the form of the white hyacinth from that of felspar. It is impossible to convey an idea of the complete refutation of this idea without the aid of diagrams. Mr. Mohs indeed allows that the inclination of the faces do not exactly answer to that indicated by calculation, but throws the blame on the inaccuracy of the goniometer.

Mr. Mohs endeavours also to controvert the justness of Mr. Hauy's statement of the primitive form of the meionite; but fresh observations made on fine large specimens confirm Mr. Hauy's statements, and he has now found the joints parallel to the base, whose position was before only a supposition. These joints are indeed not so neat as the lateral ones.

Independent of the form, meionite differs from felspar in other characters. It is deeply scratched by the greatest part of felspar, and the latter does not melt, by the blow-pipe, like the former with a boiling accompanied with noise.

Observations.—Although we should suppose that the French would have the advantage of being sooner acquainted with what is passing in Germany than ourselves, the fact is otherwise. Mr. Jameson has stated in his mineralogy, that Werner suspects nepheline and meionite of Hauy, are distinct from felspar, and that they ought to be considered as forming a species along with the glassy felspar of Klaproth.

Chemical Examination of the Schistus in which Menilite is found. By Mr. KLAPROTH.—*Journ. des Mines,* No. 118.

THIS bed of Schistus, in which the menilite is found, at Ménil-Montant near Paris, was formerly considered as a variety of polishing slate, but is now made a particular species by Werner, under the name kleb-schiefer, or adhesive slate.

The former analysis made of this slate, being different from that stated by Prof. Lampadius, it was analysed over again.

It slowly dissolved in muriatic acid without any loss of weight, although Mr. Lampadius states his specimen to have lost 27 per cent. of carbonic acid gas.

200 grains being distilled yielded 8 cub. in. of gas, being carburetted hydrogen, with a very little carbonic acid. 42 grains of limpid water came over which had a bituminous odour, and shewed traces of ammonia. The grayish black residuum was calcined, and dissolved in sulphuric acid, when silica was deposited. The sulphuric solution was evaporated to dryness, and the residuum elixiviated to take up the sulphates of lime and magnesia which were formed. The pale red residuum was then treated with muriatic acid to separate the remainder of the silica, and the muriatic solution first precipitated with caustic potash to separate the oxide of iron; and then again super-saturated with muriatic acid, and the alumine precipitated by carbonate of soda.

By this means, there was extracted $62\frac{1}{2}$ per cent. of silica, 8 of magnesia, 4 of oxide of iron, $\frac{3}{4}$ of carbone, $\frac{3}{4}$ of alumine, $\frac{1}{4}$ of lime, 22 of water and gaseous products, $1\frac{3}{4}$ being lost. Some traces were also found of potash or soda.

The gases must be looked upon as arising from some of the carbone contained in the mineral, and therefore its proportion must be increased.

Observations.—The great difference between the analysis made of this substance, by chemists of acknowledged eminence shews us how little dependence can be placed upon the analysis of compound minerals in general, and it particularly shews how impossible it is to class the stony minerals according to their constituent principles, as proposed by Dr. Thomson, and Mr. Brogniard.

It is strongly to be suspected that adhesive slate is only a mechanical mixture of earths, and that this is the cause of these variations in its composition.

On the Means of preventing Fires in Mines. By Mr. MATTHEU.—*Journ. des Mines,* No. 118.

THE coal mines in the neighbourhood of Saint Esprit having frequently taken fire, by which a great loss of coal was sustained;

all the avenues to those on fire were carefully stopped up, in order to prevent the access of the external air. This operation had the desired effect in stopping the eruption of the flame; but a workman having opened one of the pits about a month afterwards and attempted to descend into it, was killed by a sudden eruption of smoke, wherefore the pit was again closed up. The proprietors have opened new works at some distance, and they intend as soon as they find, in the progress of their works, the temperature of the mine to increase, to build up a wall with sand and clay in order to prevent the new works from taking fire by their too great proximity to the heated mass of the old work.

Observations.—This simple and obvious mode will no doubt be effective in most incipient cases; but when the fire has continued for years, or even centuries, as is the case in some mines, the great mass of heated coal would require so many years to cool, that no proprietor would think it worth his while to wait for the mine being rendered capable of being re-opened, but would rather abandon it to its fate. And there is also reason to apprehend, that when the fire has attained a certain limit, the surrounding strata will in many cases furnish a supply of oxygen to maintain the combustion without the aid of the external air, as in the volcanoes that break out spontaneously.

On the Metallurgic Treatment of Copper Pyrites, used at the Mines of Chessy, and Sainbel, in France. By Mr. GUENIVEAU. —*Journ. des Mines,* No. 118.

THERE are two species of scoriæ formed in these mines. The first is formed during the smelting of the roasted ore; it is gray, and of a metallic aspect, exhibiting plates as if crystallized, and might be mistaken for certain ores of iron. The second is formed during the smelting of the roasted matts. It has not a metallic aspect, it is brown, and of a fibrous texture. Both these scoriæ are rather compact. They have not a glassy appearance, nor hardly any frothiness. They are attractible by the loadstone, and melt before the blowpipe without any flux, yielding sometimes a slight smell of sulphur. They exhibit with borax, the usual characters of iron ores, and yield that metal by assaying in the dry way. They also yield sometimes traces of containing copper, and lastly they form a jelly when treated with acids.

These scoriæ were dissolved in concentrated muriatic acid mixed with a little nitric acid, water being added to the jelly thus formed, and the whole boiled. The residuum was heated to separate the sulphur from the silica. To the muriatic solution which did not contain any sulphuric acid, an excess of ammonia was added, the colour then betrayed the presence of copper, and a precipitate fell down which was treated with pure liquid potash to

separate the alumine from the oxide of iron. Oxalate of ammonia added to the ammoniacal liquor separated lime. An excess of sulphuric acid was then added that the copper might be precipitated by iron, from which the zinc was separated by adding a large proportion of ammonia, and the quantity of iron determined by converting it into a prussiate.

The first kind of scoriæ yielded 31 per cent of silica, 75 of red oxide of iron, and 2 of zinc, with some traces of copper, sulphur and lime, but no alumine, nor sulphuric acid: so that there was an excess of 8 per cent.

The second kind of scoriæ yielded 22 per cent. of silica, 90 of red oxide of iron, 3 of sulphur, and 3 of lime, with some traces of copper and zinc, but no alumine: so that there was an excess of 18 per cent.

By the help of Guyton's flux, the scoriæ yielded 50 per cent. of iron.

The iron is probably very little oxygenized in these scoriæ, since the weight of the products exceeds that of the substance analysed, and the muriatic solution lets fall a green precipitate on adding ammonia. Yet if the iron is supposed to be in the state of black oxide, it is difficult to explain why the pulverized scoriæ effervesce with sulphuric acid of a moderate strength, or with dilute muriatic acid, and yield hydrogen having the smell of that from iron. The scoriæ of sparry iron ore, which are not attractible by the magnet, and contain much manganese and but little iron also effervesce.

Another specimen of scoriæ from the mines of Chessy was also examined, which resembled that of the roasted ore. Its specific gravity was 3. 61. It yielded on being assayed 23 per cent. of iron, without any sign of copper. The analysis of it, was begun in the same manner as before, but sulphuric acid was added to the muriatic solution which let fall sulphate of barytes, this sulphate did not contain lime. The metals and alumine were then precipitated by hydrosulphuret of ammonia, the precipitate was first roasted to separate the sulphur, and then dissolved in nitro-muriatic acid. The sulphur, and sulphuretted hydrogen were separated from the former solution which was then precipitated by oxalate of ammonia to separate the lime from the magnesia; the magnesia was afterwards thrown down by potash. The nitro-muriatic solution of the precipitate was treated with excess of ammonia, which retained the zinc and copper in solution, but flung down the oxide of iron and alumine. These were afterwards separated by liquid potash. The zinc was separated from the copper by means of sulphuretted hydrogen.

By this mode of procedure it appeared that these scoriæ contained 35 per cent. of silica, 12 of barytes, 4 of alumine, 3 of lime, 2 of magnesia, 46 of red oxide of iron, 3 of oxide of zinc, with some traces of copper and sulphur. It was also ascertained that they did not contain either potash, soda, sulphuric acid, sulphate of barytes, manganese, or lead.

Hence we may infer that the scoriæ consist principally of silica, and oxide of iron, which unite during the fusion of the ore. The pure barytes found in these scoriæ arises from the decomposition of a sulphate of barytes which forms the matrix of the ore, the sulphur being carried off by the iron or copper. And lastly, these scoriæ may be considered as an artificial ore of iron.

The greatest part of the ore used at Chessy is very poor in copper; it is a mixture of the sulphurets of iron, zinc and copper, with some quartz and sulphate of barytes. It is roasted so as to save the greatest part of the sulphur, and being then mixed with from 7 to 10 per cent. of the scoriæ of former meltings and quartz, it is smelted. By this operation there is obtained the first and third scoriæ just examined, and 7 per cent. of a matt of iron and copper. This matt is again roasted, and re-melted with a smaller proportion of scoriæ and quartz, and then it yields black copper, a rich matt, and the second scoriæ that was examined. No iron is obtained in any of these smeltings, and the zinc is entirely volatized in the form of cadmia.

The copper ore used yields, in general, no copper by a common assay; once indeed $1\frac{1}{2}$ per cent. of copper was obtained from the roasted ore. By a scientific analysis it yields 4 or 6 per cent. of copper, and 36 to 55 of metallic iron. The matt of the first smelting contains 25 per cent. of sulphur, 25 to 27 of copper, and only 40 of metallic iron, so that of 45 parts of metallic iron introduced into the furnace only 3 or 4 remains in the matt. The black copper contains 1 or 2 per cent. of metallic iron, and the rich matt contains about 21 of sulphur, 66 of copper and 8 of metallic iron. So that these two products contain about $\frac{1}{2}$ the copper of the roasted ore, and only $\frac{1}{100}$ of the iron, the remainder of which is scorified by means of the quartz. This stone combining with the oxide of iron, not only forms a compound sufficiently fusible to let the copper and matt separate from it; but also enables the copper to separate the sulphur from the iron contrary to the usual course. Thus, by this simple process a ferruginous ore containing only 4 or 5 per cent. of copper is smelted with profit, for the latter metal.

It is already known that when the scoriæ which swims on the metal in smelting iron ore at Rives is too thick, quartz in large pieces is flung into the furnace in order to render them sufficiently fluid. Lampadius has made direct experiments on the union of silica with oxide of iron, and on extending these experiments it was found that when the silica was at least equal to the red oxide, the compound was glassy and more or less opake, but when the compound contained only $\frac{1}{3}$, $\frac{1}{4}$ or $\frac{1}{6}$ of silica, it was compact and of a metallic appearance.

Copper pyrites carefully roasted was assayed by mixing it with 14 per cent. of pure silica, and forming the whole into a paste with oil. A regulus of red copper, some grains of metal, matt, and scoriæ similar to those obtained in the great, were thus produced.

That the silica contained in iron ores does not unite with the iron, and thus hinder its reduction, seems owing partly to the great height of the furnaces, and the consequent long continuance of the ore in the fire, but still more to the presence of other earths and oxides which act by their attraction for silica. An artificial compound of silica and oxide of iron, was mixed with white marble, moistened with oil and melted in a lined crucible; metallic iron was obtained and some opake light green scoriæ which contained only $\frac{1}{5}$ of the original quantity of the oxide.

The analysis of the scoriæ of the high iron furnaces shew that the separation of the iron is still more complete, when lime, alumine, and oxide of manganese are present in proper proportion to the silica. But the presence of these earths is known to be prejudicial in the smelting of copper pyrites.

The scoriæ at Chessy resemble iron ores not only in their external appearance, and in being magnetic; but also by yielding a considerable quantity (40 per cent.) of iron on being assayed. When melted with $\frac{1}{4}$ of carbonate of lime, a good button of iron was obtained weighing $\frac{2}{3}$ of that contained in the scoriæ. There can therefore be no doubt but that they may be advantageously employed in order to obtain iron.

These facts shew that the addition of earthy substances in the smelting ores is not solely for the purpose of rendering the scoriæ more fluid, but that they also act on the metallic oxides in the ore: and therefore many new views are now opened in metallurgy.

Observations.—The elective attraction of the earths and metallic oxides towards one another in the dry way, is a part of chemistry that has hitherto been neglected, although it would without doubt afford a plentiful harvest of discoveries if conducted synthetically upon the plan of Lampadius.

Analysis of some Iron Ores used in Burgundy, and Franche-Comté, with an Examination of the Cast Iron, Soft Iron, and Scoriæ produced from them. By Mr. Vauquelin.—*Journ. des Mines*, No. 119.

In order to discover what passes in the smelting, and refining of iron, a collection was made of the ores, fluxes and products of the works in Burgundy.

The flux used at Drambon is a yellowish white limestone, it is rather hard, soluble in nitric acid with effervesceence, but leaves about 20 per cent. of sand, with a little alumine and oxide of iron. The solution contained lime, with a little oxide of iron, some phosphate of lime, and a trace of silica.

The flux used at Pesme, is a grayish white compact lime-stone, leaving about 5 per cent. of sand on solution in nitric acid. The

solution contained lime, oxide of iron, alumine, and phosphate of lime.

The phosphate in neither of these fluxes exceeded $\frac{1}{500}$ part.

The scoriæ were next examined as containing the extraneous matters in less compass.

Those from the forges of Drambon were of a blackish colour, and brilliant, like some oxides of manganese. They were very heavy, some were compact, others contained bubbles of different sizes. Their fracture is crystalline, either acicular or lamellar. Melted with potash and elixiviated, the ley was of a deep green colour; on the ley being boiled, in order to separate the manganese, it changed to an orange colour, and thus indicated the presence of chrome. The boiled ley treated with nitrate of ammonia, let fall a mixture of silica and alumine. Nitric acid was then added in excess, boiled to get rid of the carbonic acid, and afterwards precipitated by lime-water; the precipitate was slightly yellow, became green when dried, and gave an emerald green colour to borax, so that the phosphate of lime thus obtained, contained chrome. The precipitate was not entirely soluble in nitric acid, but left a deep green sediment of oxide of chrome with a little silica: the solution was colourless, and oxalate of ammonia threw down oxalate of lime, the supernatant liquor on evaporation yielded phosphoric acid. The liquid which had been precipitated by lime-water, was precipitated by newly prepared nitrate of quicksilver, and a brown yellow precipitate fell, which became green by drying, and yielded a fine green colour with borax, so that it was chromate of quicksilver with excess of oxide.

The yellowish red residuum, not taken up by the alkali, was treated with muriatic acid, when silica was left equal to about $\frac{1}{5}$ of the whole weight of the scoriæ: this contained some chrome, for it gave a greenish tinge to borax; the muriatic solution was first precipitated by ammonia, and then oxalate of lime was thrown down by oxalate of ammonia. The iron flung down by the ammonia, was dissolved in acetous acid, and the acetous solution was found to contain not only oxide of iron, but also the oxide of manganese with some alumine and lime.

Hence the scoriæ contain a great quantity of oxide of iron ad maximum, of oxide of manganese, of phosphate of iron, of chrome, probably in the form of oxide, of silica, of alumine, and of lime, some of which is probably united with phosphoric acid.

The bog iron ore of Drambon is composed of round grains of different sizes, with fragments of lime-stone; that of Chamfont is very similar, as well as that of Grosbois, which latter contains a quantity of lime-stone; that of Chatillion sur Seine, is ochre-yellow, in small grains like millet, mixed with clay, but without any lime.

All these ores contain the same principles: that of Drambon yielded on analysis, iron, manganese, phosphoric acid, chrome, magnesia, silica, alumine, and lime. No signs of nickel could be found in these ores, this metal was particularly searched for, on

account of the similarity between the composition of these ores, and the stones which have fallen on the earth.

In the chimnies of the refining furnaces, there are found stalactites, that are sometimes more than a foot long, and three or four inches diameter. They are formed of agglutinated grains, leaving considerable intervals between one another. They are red internally, and are scarcely magnetic: this sublimed iron contains also oxide of manganese, silica, phosphoric acid, and a large proportion of chrome.

The gray cast iron of Drambon, yielded on being dissolved in dilute sulphuric acid, very fetid hydrogen, and left a residuum of $\frac{1}{20}$ of its weight. This residuum was deep black, and smelt strongly of phosphorus: alkohol boiled on it took up some oil, which separated on adding water to the solution; this oil is clear, transparent, of a light citron colour, and of a sharp taste; it appears to be an intermediate link between the fat and the essential oils: the remainder of the residuum was carefully examined, and it appeared that this specimen of cast iron contained carburet of iron, phosphuret of iron, manganese, chrome, silica, and alumine. After the iron and carbone, the phosphorus was the most abundant ingredient. It seems to be owing to the residuums left in dissolving iron in acids, having been neglected, that so little is known concerning the causes of the bad qualities of some iron.

Soft iron of Drambon yielded by solution in dilute sulphuric acid, fetid hydrogen, having the same smell, but weaker than that from the cast iron; it left a residuum of three per cent. which had a less intense black colour, and had as well as the solution, a fetid odour. This residuum flung upon burning coals, emitted a white fume, and an arsenical and phosphoric smell. From other experiments, it appeared, that the soft iron of Drambon, although esteemed good, contains a sensible quantity of phosphorus. The iron of Pesmes left only $1\frac{1}{2}$ per cent. on solution, so that it contained less phosphorus. This iron is very fibrous, and esteemed one of the best in Franche Comté.

In dissolving the gray cast iron, the upper part of the bottle, as also the tube conveying the gas became greasy, as had been already remarked by Mr. Proust; and also observed in the solution of certain kinds of tin.

The fetid smell of the hydrogen obtained from cast and soft iron appeared, by treating it with ozygenized muriatic acid, to arise from phosphorus.

As the ores that were examined were taken from very distant situations, it is probable, that all the bog ores contain the same principles. These ores contain, except nickel, the same principles as the stones that have fallen upon the earth. Part of the substances remain in the iron, and are the cause of its hardness and brittleness; and the greatest part of these extraneous matter, are separated during the refining of the iron, as they are found in the scoriæ that are formed during that process, as also in the

iron that is sublimed into the chimneys of the refining furnaces. Nevertheless some of the chrome, phosphorus, and manganese are found even in the best iron, and are probably the cause of its being red-short, or cold-short; it is on the perfect performance of the process of refining that the goodness of the iron principally depends. The phosphorus and chrome ought to be searched for, not only in the solutions of iron, but also in the residuum. The carbone contained in the iron, particularly in gray cast iron, forms with the hydrogen, produced in the solution of iron, an oil, which along with phosphorus communicates to the hydrogen a fetid odour, the property of burning with a blue flame, and a greater specific gravity than usual. This oil and phosphorus may be separated from the hydrogen by oxygenized muriatic acid gas.

On the Formation of Flints By Mr. HAQUET.—*Journ. des Mines,* No. 119.

IN the chalk-pits of Volhynia, there are found a great number of flints in different sized lumps. In one place there have been found two flints about the size of a man's fist, that contained petrified roots of trees, of which the wood had not changed its colour, and appeared to be beech. Another lump found in the same place, contained a number of small splinters of wood, from whence the late formation of flint may be inferred, especially as flint is never found but at small depths, and even smaller and scarcer as they lay deeper in the ground.

The chalk in which these flints are found, contains 47 per cent. of lime, 8 of magnesia, 33 of carbonic acid, 7 of silica, 2 of alumine, and $\frac{1}{2}$ of oxide of iron.

Five specimens of flint were examined, and they were found to contain from 89 to 97 per cent. of silica, from $\frac{1}{4}$ to 4,15 of lime, and from 1 to 2 of oxide of iron; in one specimen no alumine was found, the others contained from 1 to 2 per cent. of it; 4 specimens contained no magnesia, the fifth had $\frac{1}{2}$ per cent. In like manner 4 specimens contained no oxide of manganese, but the fifth had $\frac{3}{4}$ per cent. The loss amounted from $\frac{3}{4}$ to 3 per cent.

Chemical Observations. By Mr. GEHLEN.—*Journ. de Phys.* September, 1806.

MR. Bucholz has just discovered, that pulverized chalk may be changed by heat, without compression, into a substance analogous to marble. He put 4½ lb. of chalk into an Hessian crucible, which he covered with a brick, and exposed it to a white heat for an hour, intending to prepare lime. On examining however the crucible, the chalk was found to have contracted about $\frac{1}{6}$ of its bulk. The external surface, and that next to the vessel were for about a line in thickness converted into lime; but from thence to near the middle of the crucible, the powder was changed

into laminæ strongly adhering to each other. They appeared to be half-melted, and were yellowish white, inclining to reddish. In some places they were sufficiently hard to scratch glass. Below this slaty mass was another which had undergone a greater degree of fusion. It was split into seven or eight pieces, its fracture was smooth, and flattened conchoidal, it was very difficultly frangible, and so hard on some of the edges as to scratch glass. The fragments were translucid, and sometimes transparent. This melted chalk yielded 42 per cent. of carbonic acid by solution in muriatic acid, instead of 43 as it did before its fusion.

Mr. Bucholz has also found that the magnetic iron ore of Suhl, is an oxide of iron, ad maximum, i. e the red oxide ; although it has been supposed that a maximum of oxygen destroyed the magnetic quality of iron, in the same manner as a maximum of carbone, or of sulphur according to Hatchett. Mr. B. has found only silica in the hyalite of Freyburg, or volcanic chalcedomy, but as he lost seven per cent. it is probably united with an alkali.

Mr. Klaproth has found chromate of iron at Virieglach in Stiria, mixed with a curved lamellar tale, coloured cochineal, and peach bloom red by chrome.

Mr. Haquet, of Cracow, imagines flints to be of very recent formation, as they are only found near the surface of secondary formations. They frequently contain petrified wood and roots, as also animal bodies. In some specimens, rhomboidal crystals are found, that pass insensibly from magnetic (manganesiated ?) carbonate of lime, to almost pure silica.

Observations.—The brilliant experiments of Sir James Hall, respecting the conversion of the pulverulent carbonate of lime into more compact varieties of it, have been already related in our second volume, page 265. The present observation shews, that this change may sometimes be effected by more simple means ; and as it performed without the pressure mentioned in the Baronet's experiments, it shews that this conversion may, on a large scale, be performed at a less depth than he imagined.

Darso, in a memoir, of which an abridgment may be found in our present number, has shewn that the existing opinions respecting the oxides of iron, stand on a very doubtful foundation ; and thus he comes in aid of Mr. B's observations.

On the Oxidizement of the Joints of the Leaden Boilers used in Bleach-fields. By Messrs. Fougerai de Launai, *and* Vauquelin.—*Journ de Phys.* September 1806.

The leaden boilers used in the bleach-fields near Soissons, are formed of sheets of lead soldered with the usual alloy, i. e. tin and lead. The joints of these boilers are not affected by the leys boiled in them, but if these boilers are left empty for some months, the joints become so oxidized, that the soldering must be renewed when the works recommence.

Mr. Vauquelin having analysed the oxide sent to Mr. Delametherie, by Mr. Fougerai de Launai, found it to consist almost entirely of carbonated oxide of lead with some traces of iron and tin. He thinks that the joints are oxidized by the air, by means of the carbonate of potash that composes the ley, which is itself decomposed at the same time, so that the alkali unites with the tin, and the carbonic acid with the lead.

On heating carbonate of potash with a mixture of the oxides of tin, and of lead in equal proportion, the tin was dissolved, and the lead united with carbonic acid.

On the Oxides of Iron. By Mr. Darso.—*Journ. de Phys.* Oct. 1806.

It is probable that although the quantity of oxygen is not constantly the same, yet the greatest part of the facts upon which the idea of intermediate oxidizements are founded are inaccurate.

To investigate this point, Mr. D. intended to treat the red oxide of iron along with oxygenizing substances, under great pressure, in the manner of Sir James Hall, in hopes of augmenting the proportion of oxygen in the oxide; or to pass electric shocks through iron wire, in air containing various proportions of oxygen, but he first tried experiments founded on the usual processes.

Filings of iron detonated with three times its weight of nitrate of potash, yielded a brown mass with green and iridescent spots, which when triturated and washed, formed a brown very attractible oxide, not soluble in cold muriatic acid. This oxide, dissolved in warm diluted muriatic acid, formed a colourless solution, from whence alkalies precipitated a blackish brown oxide, not changed by exposure to air, and which speedily formed so coherent a mass that it would not dissolve in cold muriatic acid: this mass was still magnetic. The properties of this oxide arose from the concentration of the solution and precipitant, for on diluting the alkali, or using lime-water, strontian-water, or barytes-water, the precipitates were quite red.

Black magnetic oxides, which do not change by exposure to air, are obtainable by mixing the green and red solutions of iron, in a certain proportion. The green salts of iron may also be precipitated in a similar form.

One hundred grains of iron filings, calcined for half an hour, weighed 120 grains. Each grain appeared to be a metallic nucleus, covered with an external layer of oxide. On grinding the oxide, and again exposing it to the fire, a green magnetic oxide was obtained, when the iron had acquired an increase of 30 to 36 grains. This calcination being pushed until the iron had absorbed 38 of oxygen, the oxide was then quite red, and not in the least magnetic. The further oxygenizement of the iron, as far as 50, was very slow, but by augmenting the heat, and blowing by bel-

lows upon the oxide, the oxygenizement was carried as far as 56. These oxides were dissolved in acids, and the solutions treated with alkalies, the alkaline earths, the prussiates, gallates, and phosphates; but no difference could be discerned between those which had absorbed 38, 40, 45, and 48 of oxygen. The oxides were however redder, and less magnetic the further the calcination had been pushed, but this appeared to depend more on the division the iron had undergone, than on the quantity of oxygen, for sometimes the oxide at 28 was entirely magnetic, and at others was quite red.

To investigate the cause of this difference, 300 grains of still finer iron filings were taken, and divided by sifting into three different finenesses. 100 grains of the coarsest were calcined, being taken from the fire every ten minutes, and triturated at the end of half an hour, it had absorbed 24-70 of oxygen, it was red, very little magnetic, and when dissolved in muriatic acid, yielded red precipitates. 100 grains of the middling fine filings were treated in the same manner, and when they had absorbed 21 of oxygen, the oxide had the same properties as the former. Lastly, the very fine 100 grains were calcined in the same manner, except that they were triturated every five minutes. In a quarter of an hour they had absorbed 15 of oxygen, but the oxide had the same properties as the other. Sometimes indeed this oxide contained two or three per cent. of green oxide, which could be separated by treatment with dilute muriatic acid. This oxide at 15 could not be distinguished in the least from one at 56.

It is perhaps possible to obtain red oxides of iron, with 6 or 8 per cent. (exclusive) of oxygen, and by preventing the access of oxygen, powders of iron might, Mr. D. thinks, be obtained, possessing the properties of oxides. It does not appear to him necessary, that metals should be combined with oxygen in order to unite with acids; this oxygenizement seems only a consequence of the methods commonly used to divide metals for that purpose. It does not seem probable that a small change in the proportion of oxygen should change the colours of metallic oxides, and therefore, when the colour of an oxide, formed by precipitation, is different from that formed by direct calcination, it may be suspected to arise from some extraneous matter. Thus, if the white or green oxide of iron is composed only of iron and oxygen, why do they not appear in the course of its calcination by fire?

Mr. Thenard says, that the white oxide becomes green by exposure to air, the oxygen of which it absorbs, and that it is also turned green or yellow by the oxygenized muriatic acid. The necessary precautions to obtain this oxide, are stated to be the concentration of the two solutions, and that it is best to form the sulphate by boiling dilute sulphuric acid upon a large quantity of iron filings. But when this sulphate of iron is precipitated by a concentrated alkaline ley, the precipitate is in fact a white sul-

phate of iron, sometimes crystallized irregularly, soluble in water, rendering syrup of violets green, and throwing down a red precipitate from infusion of litmus. The same white saline precipitate is formed if the sulphate of iron is dropped into the alkaline ley, and even if the precipitate is digested for 24 hours in potash.

A similar white salt, with excess of oxide, is obtained in a still more striking manner when the sulphate is dropped into ammonia, because its less specific gravity allows the precipitate to separate quicker.

But the sulphate of iron is precipitated green when the alkalies are diluted, or when lime-water is employed: and in like manner the muriate and nitrate of iron which are thrown down white by the alkalies, are precipitated green by barytes-water and strontian-water. Hence it is evident that the green precipitate is not a mere super-oxygenizement of the white, and indeed if the solution is diluted with sulphuretted hydrogen, the precipitates by the alkalies are always green or black, and never white, although Mr. Thenard asserts the contrary.

Three parts of ammonia added to one of sulphate of iron in a close vessel throws down a white precipitate, which by shaking up re-dissolves. If this solution is then precipitated by water or an acid, it is thrown down green or brown, but if the ammonia be abstracted by heat, it leaves a black or brownish oxide, which being re-dissolved in muriatic acid, usually gives red precipitates. Here it cannot be supposed that the iron was super-oxygenized by the ammonia.

It will be shewn in a future paper, that there are red salts of iron with excess of oxide, which are not only white and soluble, but also crystallizable and not deliquescent. It will then be shewn why some of the white precipitates, observed by Mr. Thenard, preserved their colour even when boiled; a fact which does not in the least depend upon oxygen.

As the oxygenized muriatic acid is so little soluble in water, and the sulphate so concentrated, then if the acid be sparingly employed, the small quantity of oxygen can only change a small portion of the oxide red, and this is so enveloped by the green oxide which is formed by the water employed, that it is not perceptible; but if the oxygenized muriatic acid be employed more abundantly, there can be no doubt but that it would convert the whole oxide to redness.

In lieu of the alleged absorption of oxygen, when the precipitation is made in close vessels, there is a manifest emission of gas. When the white oxide is changed to green or red, the air inclosed in the vessel extinguishes a taper, but this is owing to the presence of a principle to be mentioned hereafter.

To ascertain the proportion of oxygen in the green oxide, 90 grains of iron filings were dissolved in three separate portions of muriatic acid. One of these portions was precipitated by ammonia, and then washed and dried with the greatest speed: the precipi-

tate was brown and attractible. It weighed 36½ grains. The second portion was first diluted with five or six times as much water, and then precipitated by ammonia, the oxide was red, not attractible, and weighed 36 grains. The third portion was precipitated by ammonia, and left in the vessel for a month, being stirred twice a day, it was then dried. This oxide was red, not attractible, and weighed 36.2 grains, so that the red oxide may also be prepared in the moist way, containing only twenty per cent. of oxygen, and sometimes magnetic.

To attain still greater precision as to the quantity of oxygen absorbed, the iron might be dissolved in muriatic acid, and the hydrogen carefully collected, which would shew the quantity of water that had been decomposed; or the solution might be precipitated by an alkali, and the oxygen expelled from the precipitate, *in vacuo*, by means of a burning glass.

The green crystals of sulphate of iron dissolved in water, let fall some green oxide, but not the white crystals. The subsidence took place even if the water was purged of air by boiling. That oxygen was not, as is usually supposed, the cause is evident. From Dalton's experiments it appears, that 100 cubic inches of water, when saturated with air, contain only ½ of a cubic inch of oxygen, the greatest part of this is disengaged by boiling, and yet, if the green sulphate of iron, with excess of oxide, is dissolved in this quantity of water, it will deposit at least 15 or 20 grains of red oxide. It was also found that no alteration was produced by passing several currents of air for seven hours, through a solution of iron; or by passing three quarts of oxygen through a solution of 10 grains of iron.

On pouring some drops of alkali into a moderately diluted solution of iron, it was observed that each molecule of the oxide was formed of a very thin pellicle, whch inclosed a fluid; and therefore the colour of the green oxide, was at first attributed to the thickness of this pellicle, and its change to the disruption thereof. But the changes produced by oxygenized muriatic acid, and sulphuretted hydrogen were so very plausibly explained by the French theory of chemistry, that it would have been acceded to, if the preceding experiments had not shewn oxygen to have no influence in the colour of the oxide of iron.

In every specimen of iron examined there was formed a white precipitate, not changed by exposure to air, and yielding with prussiate of potash an emerald green precipitate. A white precipitate was also obtained from some red salts of iron, which sometimes crystallized in very soft flakes, that might be mistaken for French chalk. This was a salt of iron with excess of oxide, but both were mistaken for magnesia, which was supposed to be iron oxidized ad maximum; an opinion that was supported by magnesia being precipitated of a green colour by sulphuretted hydrogen. It was also found that lime and alumine might be precipi-

tated, by the same agent, of a similar colour. All these precipitates are changed to white by exposure to air.

These green precipitates are not hydrosulphurets, but hydrogurets, which probably retain some portion of the acid. They are decomposed by oxygenized muriatic acid, without any trace of sulphur; and being dissolved in acids, they preserve their green colour and other properties.

As these green precipitates are never formed but when hydrogen is disengaged, it appears that some part of it combines with the oxide. When the solution of the iron is mixed with six or eight times as much water, and then precipitated with a fixed alkali, a very perceptible odour of hydrogen is emitted as long as any green precipitate is formed; so that it may be known, without seeing the solution, whether it is green or red.

The influence of hydrogen was moreover demonstrated by boiling for some time a solution of iron in a retort, and then precipitating it with a solution of soda, diluted with boiling water; for hydrogen was disengaged, and the distillation being continued to dryness, the residuum contained much red oxide, with a little of the green at the bottom, from which the hydrogen had not been disengaged.

When oxygenized muriatic acid is poured into a green solution of iron, there ought by the usual theory, to be an augmentation of temperature from the different state of the oxygen in the acid, and in the new formed red oxide; but this does not happen; nor is this the only difficulty, for six grains of iron being dissolved in muriatic acid in the cold, and at the same time, in another vessel six grains of red oxide, and then the latter saturated with sulphuretted hydrogen, both were precipitated by an alkali. The precipitate from the latter soon changed red, and by pouring water upon the precipitate when separated, it became entirely red, which was not the case with the other. The precipitate from the latter solution being re-dissolved in muriatic acid, and precipitated, fell down red, if not in the first, at least in the second solution, but the other precipitate retained its colour after five or six successive solutions and precipitations.

Hence we may conclude that the oxides of iron that are soluble in acids, are always red, and that although the proportion of oxygen varies from 15 to 50 per cent. their chemical properties are alike. The supposed white oxide of iron is a salt with excess of oxide, and the supposed green oxide is a hydroguret, or combination of hydrogen with oxide of iron. The atmospheric air has no influence on the solution of iron, some of the changes require open vessels, but this is owing to the emission of some gas being necessary. When the oxides of iron are saturated with oxygen, their magnetism is not destroyed, as every oxide of iron is magnetic, or may be rendered so without any loss of oxygen.

The loss of magnetism in some oxides of iron, has been attributed to the presence of too great a proportion of oxygen, but as it was found that some oxides at 50 or 56 were magnetic, while

others at 20 were not attractible, it was evident that this was not the cause. It appeared rather to depend on the state of extreme division in which the unmagnetic oxides were produced. Thus, as above stated, the oxide precipitated from a concentrated solution, by an undiluted alkali was blackish brown and magnetic; while that from a diluted solution by a dilute alkali was red and not attractible, yet each oxide contained the same proportion of oxygen. It has also been shewn, that when extremely fine filings of iron were calcined, a red oxide was obtained which had absorbed only 15 per cent. of oxygen, and was much less magnetic than the common oxides, that had absorbed 30 or 40 per cent. The unmagnetic oxides become magnetic by ignition, yet the experiments of Proust and Berthollet shew that no oxygen is emitted by these oxides, however strongly heated. It would therefore rather appear probable that in the unmagnetic oxides, the molecules are so small that the seat of the magnetic poles are, as it were, confounded, and hence the difference between the attraction and repulsion being inappreciable, the oxide does not exhibit any sign of magnetism.

Observations.—The facts contained in this paper, are extremely hostile to Lavoisier's theory of the calcination of metals, and still more so to Proust's ideas respecting the existence of only two oxides of iron, viz. that ad maximum, and that ad minimum. At the same time we cannot help bestowing some credence to Mr. Darso's experiments, as they appear to have been conducted with caution.

On Volcanic Substances. By Mr. Louis Cordier.—*Journ. de Phys.* September 1806.

It has been found in examining the mountains of Auvergne, that all the ferruginous sands attractible by the magnet which are found in volcanic countries are composed of the oxides of iron and of titanium, except those which are formed of specular iron ore, which latter are however very rare.

The greater part of lavas contain a notable proportion of oxide of titanium.

The porous or massive *granitoides* of the extinct volcanoes in the interior of France are composed of felspar, pyroxene, (augite), and iron holding titanium. These are perfectly similar to the green granitello of the Meisner mountain in Germany, that Werner calls secondary green-stone, and which has hitherto been supposed to be composed of felspar and amphibole, i. e. hornblende.

On some Granitoid Lavas. By Mr. J. P. Daubuisson.—*Journ. de Phys.* November 1806.

Some granitoid lavas are, notwithstanding the discovery of Mr. Cordier, composed of amphibole (i. e. hornblende) and felspar.

A specimen from Cantal is composed, 1. of amphibole in long

very black crystals, distinctly lamellar, and having a very distinct fracture whose angle is 124°. 2. of crystals of felspar, with a glassy appearance like most volcanic productions. 3. of a blackish gray matter full of small pores: this substance generally predominates over the amphibole, but not always. This lava is a true secondary green-stone, but if these crystals should become insensible, as they no doubt do in some places of the rock, a compact black basaltic rock would be formed, which would be a real compact green-stone, composed of amphibole and felspar.

There may however exist basaltic masses formed of felspar and augite, in the same manner as some petrosiliceous porphyries are only compact sienite, i. e. composed of felspar and amphibole, while others are compact granites, i. e. composed of felspar, quartz, and mica.

The error respecting the composition of the rock of the Meisner mountain arose from augite having been formerly confounded with hornblende. Werner at first stated the rock to consist of felspar and hornblende; he then separated augite from the latter species; but his followers still continued to repeat his assertion respecting the composition of the rock, forgetting that the component part which he then called hornblende, he now denominated augite. Some part of that which has been taken for amphibole (hornblende) in the rock of the Meisner is partly green felspar, and partly pyroxene, (augite), but Mr. D. will not positively affirm that it does not contain any amphibole.

Observations on Blende. By Mr. Proust.—*Journ. de Phys.* Fevr. 1807.

Zinc has a slighter attraction to oxygen than either carbone or sulphur, and yet when yellow transparent blende was heated along with fir charcoal, and afterwards washed, it was found not to be altered. Neither was it altered by being heated with an equal quantity of sulphur. Hence it appears that blende is saturated with sulphur, and that it does not contain oxygen.

125 grains of oxide of zinc heated with sulphur yielded sulphurous acid gas, and left 118 of an artificial pulverulent blende, which probably might be melted by a sufficiently strong heat.

As blende is sometimes transparent, it is supposed to contain oxygen, yet neither cinnabar, nor sulphuretted arsenic contain oxygen. Oxide of arsenic and its acid yield sulphurous acid gas by being heated with sulphur, and form transparent sulphurets, entirely similar to those formed of the regulus itself. But it is very remarkable that metallic zinc is not directly combinable with sulphur. The sulphuret of zinc impregnated with oxides and other sulphurets, acquires various colours; but these can no more form specific distinctions than the different colours of dyed cotton.

Some blendes coloured with red oxide of iron, appear black, but their powder is red; when treated with muriatic acid, the oxide is changed to the black, by the sulphuretted hydrogen that is formed. Others contain oxide of lead or its sulphuret; if these are analysed by muriatic acid, the lead is found in the solution, but if the nitric acid is used, it remains in the residuum, on account of the sulphur being acidified, and precipitating it in the form of a sulphate.

Sulphuretted hydrogen precipitates from solutions of zinc a yellowish white hydrosulphuret of zinc, but when a portion of the oxide has fallen down, the residuary acid prevents any further precipitation until its excess is neutralized by potash. Alkaline hydrosulphurets produce similar precipitations. Nitric acid acts on hydrosulphuret of zinc, and its oxygen combines with hydrogen and part of the sulphur. Muriatic acid only disengages sulphuretted hydrogen. If the hydrosulphuret is distilled it yields water, sulphurous acid, and leaves the simple sulphuret, or blende. Both native and artificial blende yields sulphuretted hydrogen, which is produced by the decomposition of water in the same as when acids are applied to metallic zinc.

On Ambergris. By Mr. Proust.—*Journ de Phys.* Fevr. 1807.

A specimen of ambergris of an uniform honey yellow colour from the coast of Brazil, which did not contain any cuttlefish bones was almost totally soluble in alkohol, a few pellicles only remaining. This solution was precipitated by water; on evaporation it yielded a yellow resin, scarcely if at all soluble in potash, and not yielding an ammoniacal smell when treated with that alkali. This resin smelled like amber; on being distilled, it melted but did not swell, and it yielded a yellow thick oil, lighter than water; and smelling like amber, with some traces of an acid.

Observations on Cochineal. By Mr. Proust.—*Journ. de Phys.* Fevr. 1807.

The powder of cochineal appears to be always acid. It forms by being precipitated with lime-water, a lake on which alkohol has no action. If this lake were to be decomposed by acids, the colouring matter might be obtained in a pure state. As oxide of tin or of lead also combine with the colouring matter, it may be obtained purer by being separated from them by sulphuretted hydrogen, than by acids from the lime.

The colouring matter of kermes is probably also combinable with lime.

NATURAL PHILOSOPHY, ARTS AND MANUFACTURES.

I. *On the apparent Attraction and Repulsion of small Bodies floating on the Surface of Liquids.* *By* Mr. LAPLACE. —*Journ. de Phys.* September, 1806, *or Phil. Journ.* No. 73.

II. *On the Adhesion of Bodies to the Surface of Fluids.* *By* Mr. LAPLACE.—*Journ. de Phys.* Nov. 1806, *or Phil. Journ.* No. 73.

III. *On Capillary Action.* *By* Mr. LAPLACE.—*Journ. de Phys.* December, 1806, *or Phil. Journ.* No. 74.

IV. *Remarks on some Difficulties which occur in the Investigation of the Capillary Action of Fluids.* *By* ALETES.—*Phil. Journ.* No. 76.

I. IN the first of these papers, Mr. Laplace refers to his former demonstrations respecting the attraction of two vertical and parallel planes very near each other, with their lower extremities immersed in a fluid, (See Retrospect, vol. ii. p. 137.) He now pursues the subject of the repulsion of bodies similarly situated, one of which causes the fluid to rise, and the other depresses it. He observes that the surface of the fluid between two such bodies, has a point of contrary flexure in the plane of the general horizontal surface, until they approach very near, when, if the elevation and depression are unequal, the repulsion will be converted into an attraction, at the instant that "the fluid is equally elevated on each side of the plane that is capable of being wetted, and as much elevated above the level at the interior of the other plane, as it is depressed below it at the exterior;" and after this they will attract each other more and more, and proceed to unite with an accelerated motion. The mode of computing the magnitude of these forces is a very obvious deduction from the principles by which their existence is demonstrated. When the planes are very near together, the elevation of the fluid between them is equal to the half sum of the elevations which would have taken place, if the first had been similar to the second, or the second to the first. The repulsive force is in general much weaker than the attractive; and the tendency of the planes to approach each other, follows ultimately the general law of attraction, being in the inverse ratio of the square of the distance. The truth of this change of a repulsive into an attractive force has been completely confirmed by some experiments of Mr. Hauy on a leaf of talc and a piece of ivory.

Observations.—Mr. Laplace is not perfectly correct when he intimates, that at the neutral point the fluid is always equally elevated on each side of one of the planes; for if it should happen that the depression near one of the bodies is naturally greater than the elevation in contact with the other, the depression would in this case be equal on both sides of the first, and an equal elevation

and depression would happen on the opposite sides of the second. He says, that the "integration of the differential equation" of the surface "becomes possible" at this neutral point, although impossible in general. But if it can be integrated in this case, on every supposition with respect to the attractive powers of the surfaces, it may be integrated in general: consequently some mistake must have been committed in this instance.

II. In the second memoir, the celebrated author observes, that "a great number of experiments have been made on the adhesion of bodies to the surface of fluids, but without any suspicion, that this adhesion was the effect of capillary action," and that Dr. T. Young appears to him "to be the first who made this ingenious remark." When a disc of glass is applied to the surface of water contained in a vessel of considerable extent, on endeavouring to separate it from the water we find a certain resistance; and on raising the glass we raise at the same time a column of water above the level of the surface, which resembles in its figure, a grooved wheel or pulley. Its base extends without limit on the horizontal surface; it diminishes to about seven-tenths of its height, and then enlarges, so as to adhere to the whole of the lower surface of the disc. On raising the surface higher, the weight overcomes the capillary action, and the column separates; consequently the weight of the column thus raised is the measure of the resistance. When the fluid instead of rising would be depressed in contact with the substance of the disc, the column has no longer the form of a pulley, but decreases continually till it comes into contact with the disc.

If we place two discs of glass horizontally on each other, with a thin stratum of water between them, they will adhere with considerable force: and the interposed fluid will take the form of a pulley, the smallest radius of curvature being nearly equal to half the thickness of the stratum. Hence the adhesion thus produced will be equal to the weight of a cylinder of water, the base of which is the surface of the disc, and its altitude the height to which water would rise between the two parallel planes, if placed vertically in an open vessel.

When a small body is supported on the surface of a fluid specifically lighter than itself, it is in consequence of the depression of the fluid round it, which together with the immersed part of the solid, displaces so much as is equal in weight to the whole body. And when a body floats, and is surrounded by an elevation of the fluid, it is obvious that it must be immerged to such a depth as to sustain the additional weight of the fluid raised by the capillary action. Two needles supported in this manner, their surfaces being either varnished, or greasy, or surrounded by a thin coat of air, afford a convenient mode of examining the attractions produced by the action of these forces; they not only approach each other, but are carried beyond the state of equilibrium, and then return, so as to oscillate, until their motion is destroyed by the resistance.

These capillary forces, Mr. Laplace observes, are the causes of chemical affinities; they do not stop at the surfaces of bodies, but, penetrating to depths which, although imperceptible to our senses, are sensible in the action of affinities, produce that influence of masses in chemical combinations, of which the effects have been so happily displayed by Mr. Berthollet. This attraction, "combined with the figure of capillary spaces, gives rise to an almost infinite variety of phenomena, which, like those of the celestial bodies, are *now* brought within the domains of analysis."

Observations.—The author attempts to compare this theory of capillary action with the different experiments of Mr. Hauy and of other observers: with this view he appears to have selected such as best suited his purpose, and by a little of the art of Procrustes, of lengthening and shortening, which is so well understood by modern philosophers, he has accommodated them tolerably well with each other. When a piece of glass is perfectly dry, it may often be observed that the surface of water in contact with it, instead of having a common tangent, forms a considerable angle with it; and if an experiment be performed under such circumstances, the capillary attraction will be apparently much diminished, and probably without any absolute limit at which this irregularity will cease; if on the other hand the glass be perfectly wet, there is a maximum which can never be exceeded, and which affords the true measure of the magnitude of the forces concerned. This consideration is necessary for understanding the striking difference between the experiments of Newton and Hauy, which nearly agree together, and those of almost all other philosophers, who have found the ascent of water in similar circumstances about twice as great; without supposing Mr. Hauy to have been unduly biassed by the authority of Newton, whose experiments it was his object to verify. Mr. Laplace has applied this erroneous estimate of Mr. Hauy to an experiment of Mr. Achard, which he has either quoted inaccurately, or selected purposely on account of its differing considerably from the mean result of Mr. Achard's experiments, and finds that they agree tolerably well with each other. This selection of the experiment in which the attraction appeared the weakest is every way indefensible, because there are many causes which might concur to diminish the apparent attraction, and not a single one which could possibly increase it. In the same manner when he examines Morveau's experiment on the cohesion of two discs, he finds the resistance greater by one third than would be inferred by calculation from Mr. Hauy's observations; but he insists that this difference must have arisen either from some error in the estimation of the interval, or from some irregularity of the surfaces; although any such error would be much more likely to diminish than to increase the resistance.

III. The third essay is in great measure independent of the former investigations of Mr. Laplace; the method adopted in it

is very simple and general; it resembles in some measure, if we mistake not, the mode of demonstration employed in Dr. M. Young's Analysis, although it is certainly much more unexceptionable. He begins with shewing that the weight of the fluid supported in any prismatic and vertical tube, is equal to the length of the interior circumference of the prism, multiplied by a certain constant quantity; and that this quantity for the same fluid is proportional to the excess of twice the attractive force of the solid above that of the fluid. His reasoning is exhibited in a condensed form, by the anonymous author of the fourth paper. The attraction of a capillary tube, which tends to elevate the column of fluid contained in it, consists of two equal parts, one of which is derived from the action of the portion above the fluid on the upper part of the column, the other from that of the end of the tube on the imaginary continuation of the base of the column, a little below the tube; and these forces are opposed by the attraction of that part of the fluid which forms an imaginary continuation of the tube, tending to draw the column downwards, in the same manner as each of the other forces draws it upwards: so that the weight of the fluid elevated, must be proportional to the excess of twice the density of the solid above that of the fluid. Mr. Laplace compares this proposition with the experiments of Gellert on rectangular and triangular tubes, and finds that they agree as well as could be expected from the degree of accuracy with which these experiments appear to have been performed. Secondly, if the vessel into which the tube is immersed, contain fluids of different kinds, the weight sustained in consequence of the capillary action will be the same as if the vessel contained only that fluid in which the lower end of the tube is situated; the only effective action being exerted on this fluid. Thirdly, if the tube be wholly immersed, and its superior part be in one, and its inferior in another; of two fluids contained in the vessel, the weight of the portion of the lower fluid raised above its natural level, considered as situated in the upper, will be equal to the difference of the weights of the two fluids which would be separately supported in the same tube. Fourthly, where the tube is inclined to the horizon, the relative weight of the fluid elevated will be the same as when it is vertical, and the actual quantity raised will be inversely as the sine of the angle formed by the tube with the horizon. Fifthly, the space between two parallelopipeds, the one being placed within the other, may be considered as a single tube. Sixthly, if the parallelepipeds be of different substances, the weight of the fluid raised may be determined from the length of the line of contact of each with the surface, considered as acting independently of the other in raising its appropriate weight. Seventhly, the angle formed by the termination of the fluid is investigated with the assistance of the author's former demonstrations; his reasoning may again be thus briefly expressed, as in the fourth paper. Supposing the fluid to be elevated in a very narrow

space of a given breadth, the half of this breadth being the radius, the secant of the angle of contact will become equal to the radius of curvature of the surface, which is always inversely as the height of the elevated column; hence, the cosine of the angle of contact will be directly as the height; that is, as the difference between the density of the fluid and twice that of the solid, the whole density of the fluid being represented by the radius. Lastly, for discs of the same diameter raised from a given fluid, the squares of the forces required to separate them are proportional to the magnitude of the attraction; and if different fluids be thus compared, the squares of the forces, divided by their specific gravities, will shew their comparative attractions. It must however be observed in all cases, that where the attractive power of the solid is greater than that of the fluid, it must always be supposed to be covered by a thin stratum of the fluid, which becomes the immediate agent in all the effects of the capillary force.

IV. The anonymous author of the fourth paper appears to be no novice in the consideration of this abstruse subject; it is not easy to assign the motive that can have induced him to adopt a fictitious signature, unless it may have been the desire of avoiding personal controversy. His object is to shew that there is some deficiency in the modes of reasoning which have been employed both by Dr. Young and by Mr. Laplace, and he seems not to have been wholly unsuccessful in his endeavour to supply the deficiency. Mr. Laplace's first investigations are founded, he says, on a false principle with respect to the attraction of a body terminated by a plane surface on an internal column perpendicular to this surface, and lead to a false conclusion respecting the angle formed by the surfaces of solids and fluids in contact with each other; a conclusion which has probably induced the author to attempt the solution of the problem in a manner totally different, although he has not acknowledged any change of his sentiments on the subject: and throughout the whole of his inquiries, Mr. Laplace has omitted the very obvious consideration, that the attractive force which tends to bring the particles of bodies together is in general held in perfect equilibrium by an equal repulsive force; so that the difference of these forces only can be supposed to produce a result, which is capable of counteracting the force of gravitation, or of producing any other capillary effects. Dr. Young, he thinks, has failed in demonstrating mathematically the connexion between the opposition of the forces of cohesion and repulsion and the general law of a superficial tension, which he has attempted to deduce from it. "There appears," he says, "to be only one way of avoiding these difficulties, which is, to suppose that a *part of the force of repulsion* only is concerned in that action which is observed at sensible distances, while another part is so confined to the particles in immediate contact with each other, that if we suppose a liquid to be divided by any imaginary plane surface, the particles on one side of this surface can only act on the particles

on the other side in a direction perpendicular to it, leaving them completely at liberty to move without resistance in the direction of the surface itself. This hypothesis has been tacitly assumed by Mr. Laplace, with respect to *the whole* force of repulsion ; but in any shape it is still a *hypothesis* only, and the reasoning founded on it can only be considered as demonstrative, so far as its results are justified by a coincidence with facts and experiments."

The author then proceeds to deduce from this supposition the laws of capillary action partly in the manner of Mr. Laplace and partly in that of Dr. Young ; and he shews that in all circumstances which can be expected to occur in nature, the superficial parts of every fluid must exhibit the effects of a surface extended in every direction by an equable force. He adds an investigation of the force by which two bodies can act on each other, in consequence of the mutual and equal attractions of such of their particles as are within a given distance of each other ; and he shews that a particle in contact with the surface of such a body is attracted by it with half as much force as if the whole of the particles within the hemisphere of attraction were situated in the same line, and that two bodies in contact attract each other with half as much force as either of them would attract the whole of the particles of the other within its reach, if they were all in immediate contact with its surface. He observes also, that the particles situated at or very near the surface of any body must in such a supposition be attracted with a much smaller force than that which would be required in order to produce a separation in the internal parts of the body ; and that this may perhaps be the reason, " why the superficial particles of liquids are easily detached by the action of heat, in the process of slow evaporation."

General Observations.—We cannot avoid renewing, on this occasion, a complaint which has already been frequently made by many British philosophers, of an obvious want of candour in our continental neighbours, with respect to the claim of originality in the authors of scientific investigations or discoveries. We do not profess to determine the merits of such cases with perfect impartiality or infallibility ; we have perhaps our feelings and our prejudices as Englishmen, and we wish all possible allowance to be made by our readers for the influence which these sentiments may have on our decisions : but we must not therefore refrain from speaking what appears to us to be just and true.

Whether or no Mr. Laplace had received any account of the proceedings of the Royal Society at the close of the year 1804, before he communicated his first paper to the institute, at the end of 1805, we have not any positive means of determining. But if he had not seen the first part of the Philosophical Transactions for 1805, he may and ought to have seen it ; the charge of plagiarism may be avoided by proving the negative, but the claim of originality must fall, as far as a coincidence can be shewn. But

in the second of the papers here noticed, Mr. Laplace expressly acknowledges that he has taken *one* idea from Dr. Young's paper, without making any remark on the striking resemblance of almost every other result of his own speculations with some of the propositions which Dr. Young had before advanced. The natural inference which would be made by a reader of this paper, is not only that Mr. Laplace had borrowed nothing else from Dr. Young, but that all his conclusions, with this one exception, were entirely original, and had not occured either to Dr. Young or to any other person.

Now, in the first place, the sequel of the same paper contains an examination of the force of cohesion of two moistened surfaces, as derived from the effects of capillary attraction, which is by no means included in the acknowledgement relating to the adhesion of bodies to the surfaces of fluids, but which is certainly borrowed, in its whole extent, from the same paper: and, in the second place, the coincidences, which on the most favourable supposition respecting Mr. Laplace's originality, required at least to have been mentioned, extend to every part of his investigations, without any material exception; for the case of a repulsive force between two floating bodies, converted, at a certain distance, into an attraction, is a consequence so easily drawn from the general principles of the theory, that the problem required only to be distinctly stated in order for its immediate solution. To say nothing of the ideas which Mr. Laplace has advanced as new, without seeming to be aware that they had occurred to former authors, the most strongly marked of those which he maintains in common with Dr. Young, are, besides what we have already mentioned, first, the explanation of the apparent attractions and repulsions of floating bodies from the effects of hydrostatic pressure and attraction only; secondly, the agreement of the law of this apparent attraction with that of gravitation; thirdly, the deduction of the cause of the motion of a drop of a fluid situated between two inclined plates from the force of capillary action; fourthly, the determination of the angle of contact of a fluid with a solid of given attractive powers; and fifthly, the investigation of the circumstances which must take place at the common surface of two fluids of different densities. Hereafter, perhaps, some other ideas may be found in the paper on the cohesion of fluids, which may be thought of sufficient value to be "drawn to French wire" in the future essays of Mr. Laplace.

It is easy to foresee what answer this illustrious mathematician would probably return to our remarks: he has even thrown out some hints which appear to be purposely intended to anticipate them. "The resemblance," he says, in the second of these papers, "of the figure of fluids raised, depressed, or rounded by capillary action, with the surfaces generated by the curves known by the name of catenaria, lintearia, and elastic curve, led some philosophers to suppose, that the surfaces of fluids had a uniform

tension, like elastic surfaces. Segner, who appears to have been the first that suggested this idea, was well aware that it could be no more than a fiction, adapted to represent the effects of an attraction between the molecules, decreasing with great rapidity. This able mathematician endeavoured to demonstrate, that this attraction must have the same results: but if we examine his reasoning it is easy to perceive its inaccuracy; and we may conclude from the note appended to his researches, that he seems not to have been satisfied with it himself. *Other philosophers,* resuming the idea of a uniform tension of fluid surfaces, have applied it to *various capillary phenomena,* but they have not been more successful than Segner in the explanation of this force; and the most able have contented themselves with considering it as a means of representing the phenomena. In giving into all the *conjectures* which may arise from the *first view,* of these phenomena, we may hit on some truths; but they will almost always be mingled with many errors; and the *discovery* of them *belongs only to him,* who separating them from this mixture, goes so far as to establish them *on solid foundations* by observation or mathematical investigation." And again, in the third paper, "What *I* advance is founded on geometrical reasonings, and not on *vague and precarious considerations,* which ought to be strictly banished from natural philosophy; unless, imitating Newton in his Optics, we give them merely as conjectures, calculated to guide us to further researches, but leaving the *merit of discovery* almost wholly to him, who shall establish them on *solid foundations* by observation or analysis."

To this we should reply, that Mr. Laplace's investigations are by no means built on principles purely mathematical, but that they derive their authority merely from their coincidence with experiment. The best proof of this assertion is the erroneous proposition to which they had led the author, and which he has been obliged to abandon, because it did not agree with observation. This has been sufficiently explained by the anonymous author of the fourth paper, who has also shewn, in a manner apparently satisfactory, that the principle of a uniform tension is really founded in nature, and is applicable to all the phenomena of capillary action; and who seems to have examined its connexion with the general properties of matter in a more accurate manner than either Mr. Laplace or Dr. Young. We must however be contented with experimental proof for the complete establishment of this principle, which has been adopted, although in disguise, by Mr. Laplace himself, with the parade of a demonstration, which, however prolix, appears ultimately to add nothing to the weight of the evidence which had before been deduced from observation. Proceeding then upon this ground, it seems, that notwithstanding the useless affectation of abstruse calculations, Mr. Laplace has obtained no one conclusion of any consequence which Dr. Young has not before laid down, and strictly, although perhaps too concisely, demonstrated: nor has he even attempted to employ the vast and acknowledged extent of his analytical knowledge, even

in facilitating, or in rendering more accurate, any one of the calculations relating to the subject. As to Segner's diffidence of the sufficiency of his own demonstrations, it is certain that he had made some essential and palpable mistakes in omitting the consideration of the effects of a double curvature; it is therefore much more natural to suppose that he had discovered these errors, than that he had imagined others where their existence is still a matter of doubt.

Method of Adjusting a Transit Instrument in the Plane of the Meridian. By Sir H. C. Englefield, *Bart. F. R. S.—Phil. Journ.* No. 68.

The method recommended in this paper is to find a star of which the northern meridian altitude is about 5°, and the right ascension the same as that of the pole star, and having placed the instrument, with its axis accurately levelled, in a plane very near that of the meridian, to observe the difference of the times of the transits of these two stars, whence the angular distance of the plane of the instrument from the true meridian may be calculated. Or, finding a star which passes the meridian a little before the pole star, to observe its transit, and then directing the instrument to the polar star, to follow its motion by means of the horizontal adjustment, until the given difference of right ascension in time shall have elapsed; this will bring the instrument extremely near to the true meridian, and by repeating the observation, it may be fixed with still greater accuracy.

Observations.—The first of the methods proposed by the learned and accomplished author of this paper appears to be only applicable to an instrument which is furnished with a graduated horizontal circle; for without some mode of measuring a horizontal angle it would be difficult to make use of the correction obtained from the observation: nor has he explained the precise mode of calculating this angle; for the computation inserted as an example is a determination of the difference of time of the transits, produced by a given error of the instrument, which is the reverse of what is practically wanted. The second method is much less objectionable, and nearly coincides with one of the modes of determining a meridian laid down by Lalande; the star which he mentions is the first, or northernmost in the tail of the great bear; and if we wait $6\frac{1}{2}$ minutes after its transit, the pole star will be exactly in the meridian; so that by means of this star the adjustment may be made with great facility.

Observations on Professor Leslie's Theory of Caloric.—by Dr. Halliday.—*Phil. Journ.* No. 68.

Dr. Halliday had made some experiments on the radiation of heat rather with a view of confirming than of examining

Mr. Leslie's theory of its propagation; but he is obliged to confess that his faith in that theory has been somewhat shaken by their results.

Dr. Halliday admits with Mr. Leslie, "that the calorific emanation is incapable of permeating solid substances which are opaque; but when *light* can pass through," he is "inclined to believe, that *radiant caloric* is also capable of finding its way." It does not however appear that his experiments were materially different from those of Mr. Leslie; he found that a pane of glass transmitted a certain quantity of heat from a vessel containing hot water to a thermometer placed beyond it, and that this heat was much greater when the glass was placed near the vessel, than when it was at the distance of a foot. Hence Mr. Leslie concludes that the cause of the elevation of the thermometer is in both cases the heating of the glass and the new radiation of heat from the glass to the thermometer. Dr. Halliday on the contrary allows that the principal part of the heat is derived from this circumstance when the glass is near the vessel but asserts, that still a part of the original radiation passes through the glass; and he maintains this opinion by an examination of the temperature of the glass itself, when placed at the distance of a foot from the vessel, which he cannot observe to be in the slightest degree elevated by means of a very delicate air thermometer, although the thermometer beyond it is very sensibly affected. The apparent non-transmission of radiant heat through a sheet of ice, Dr. Halliday considers as depending on what may be figuratively called the emission of frigorific rays from the ice itself.

With respect to the experiments which Mr. Leslie "regards as the *experimentum crucis*," Dr. Halliday thinks it "does more to establish the fact, that part of the radiant caloric does pass through glass, than to make good his own theory; for here we see the effect produced, when there is a certainty that none of the radiant caloric can pass, and we find that this effect is less *cæteris paribus*, by two degrees, than when there was a possibility that some part of it might pass: and if we compare that with the quantity which passed through the glass in the former experiment, we shall find that they are nearly equal."

Observations.—We have always considered Mr. Leslie's elaborate work on heat as much more valuable on account of the numerous and well chosen experiments which it contains, than for the sake of any of the opinions which he has advanced in it; and we could even wish that he had condescended to describe many of his experiments somewhat more minutely and circumstantially, since in their present form they can scarcely be applied to the illustration or examination of any theories but his own. In this instance Dr. Halliday appears to have made some very judicious remarks on such of Mr. Leslie's experiments as relate to the interception of radiant heat by transparent bodies. He seems however to have been a little hasty both in becoming "a convert,"

in the first instance to Mr. Leslie's theory, and also in returning, the moment that his "faith" was "shaken," to his former opinions. Mr. Leslie's hypothesis of the propagation of heat through the air by means of the undulations of this fluid with the same velocity as the pulsations of sound, is an awkward attempt to reconcile the existence of caloric as a separate fluid with a variety of facts which seem to contradict the common opinions respecting its transmission; nor is it possible to form a distinct idea of the nature of such a complicated fluctuation upon any principles of mechanical science; to say nothing of the want of direct experiments for comparing the velocity of its motion with that of sound, which might so easily have been instituted. Sound is communicated by an undulation of the air, because sound is a motion of the air; a wave is transmitted on the surface of water, because a wave is an elevation or depression produced simply by the *motion* of the water, but how a *substance,* mixed with the air, can be transmitted by an undulation of the air, we are totally at a loss to form an idea. The only comparison that appears to be applicable to such a complicated action, is that of a body floating on the surface of a fluid agitated by waves; but such a body is either not at all propelled from its place by the waves, or at most advances with a velocity far short of that of the waves themselves, as when it becomes necessary, in navigation, to make a certain small allowance for the swell, which is rather on account of the effect of the wind which has caused the waves, than on that of the waves themselves. Besides, if culinary heat only be thus transmitted, how is it conceivable that there should be so essential a difference in the radiation of the invisible heat derived from the sun, and that of terrestrial origin passing through the same medium? For there can be no doubt but that the velocity of all the solar heat is equal to that of light; and the radiation of such heat appears, as far as we can observe, to be precisely similar to that of culinary heat; although from a remarkable attachment to his own opinion Mr. Leslie has persisted in rejecting the most ample evidence of the existence of these invisible rays.

Description of a New Astrometer for finding the Rising and Setting of the Stars and Planets, and their Position in the Heavens. By David Brewster, A. M.—*Phil. Journ.* No. 70.

This astrometer consists of four divided circumferences, all on the same plane, and having a common centre. The innermost of these circumferences is moveable round that centre, and is divided into 24 equal parts to represent hours; which again are subdivided into quarters and minutes, when the circle is sufficiently large. Supposing the plane of the instrument placed vertically, and the two *twelves* posited at the extremities of the vertical diameter of the smaller circle, then the 12 divisions on the left hand

represent the morning hours, and those on the right hand the afternoon hours. The second circumference (estimating from the centre outwards) is composed of four quadrants of declination, divided by means of a table of semi-diurnal arcs adapted to the latitude of the place; and in such manner that, adverting to the position just described, the zero of the scales of declination will be opposite VI, VI, on the scale of hours, and these scales each occupying a quarter of a circle (though containing only as many degrees as are equal to the co-latitude of the place) will be set off both ways, from the VI, VI, to the XII, XII, standing upon the vertical diameter. The intermediate degrees of declination are then laid down by means of a table of semi-diurnal arcs: thus, supposing the latitude to be 51 degrees, north, the 10th degree of south declination must stand opposite *5 h.* 13 *m.* in the afternoon, and *6 h.* 47 *m.* in the morning; because 10 degrees south declination gives a semi-diurnal arc of *5 h.* 13 *m.* The scale of declination thus constructed has an index, called for the sake of distinction, index B, placed in the upper or south part of the vertical diameter. The two exterior circles are added to the astrometer, for the purpose of finding the position of the stars and planets in the heavens. The outermost of these is divided into 360 degrees, or 4 quadrants, each being graduated from the left and right hand extremities of the horizontal diameter (these representing the east and west points respectively) to the uppermost and lowermost points, which denote the south and north. The remaining circle, or third reckoning from the centre, is a scale of amplitudes, and is so formed that the amplitude of any of the heavenly bodies may be exactly opposite the corresponding degree of declination in the adjacent circle. The instrument is likewise furnished with a moveable index turning upon the centre like that of a theodolite, and having at its extremities vertical sights forming with the centre one right line.

To shew the rising and setting of the stars by this instrument move the horary circle till the index B points to the time of the star's southing; then opposite to the star's place, in the appropriate scale of north or south declination, will be found the time of its rising on the left hand side of the instrument, and of its setting on the right hand side. The times of the star's culminating and setting, may be found from that of its rising; or those of culminating and rising from that of setting, may also be ascertained by an equally obvious process. Again, if it were required to find the name of any particular star observed, place the astrometer due north and south, and when the star is near the horizon either at its rising or setting, shift the moveable index till the two sights point to the star: so will the edge of the index point out on the exterior circle, the amplitude of the star. With this enter the third scale from the centre and find the declination in the second circle. Shift the moveable horary circle till the time at which the observation is made be opposite the star's declin. and the index B will point

to the time when it passes the meridian. The difference between the star's southing and noon converted into degrees of the equator and added to, or subtracted from the sun's right ascension, as occasion may require, will give the star's right ascension: from which with the declination, the star may be ascertained by consulting a table of the right ascensions and declinations of the principal stars. Various other problems may easily be solved by this instrument: but they need not be described here.

Observations.—This instrument is intended as an improvement upon one formerly invented by M. Jeurat; and it is certainly more simple in its construction, as well as much more extensive in its application. It will to many persons be extremely useful, especially in abridging the computation of semi-diurnal arcs, where great accuracy is not necessary. In its construction Mr. Brewster recommends a table of semi-diurnal arcs published in the *Tables de Berlin*, tom. iii. Those who have not opportunities of consulting that work, may turn to the second volume of *Vince's Astronomy*, where there is a table of semi-diurnal arcs, carried on to 32 degrees of declination N. and S., and of amplitudes carried as far as 23½ degrees of declination. The tables may easily be extended for any assumed latitude, by these proportions. 1st. As radius : tan. declin. :: tan. latitude : co-sine of semi-diurnal arc in degrees, which may be converted into time at the rate of 15 degrees to an hour. 2dly. As co-sine lat. : sin. declin. :: rad. : sin. amplitude, which is north or south as the declination is. In these cases the declination cannot exceed the co-latitude of the place; because stars whose declination goes beyond that limit either never set or never rise, according as the declination is like or unlike to the latitude.

Description of an Improved Hygrometer. By Lieutenant Henry Kater.—*Phil. Mag.* No. 108.

In Mr. Kater's Hygrometer the hygroscopic substance is the beard of the grass known in the Canarese language, by the name of *Oobeena Hooloo*, being the *Andropogon contortum* of Linnæus. It is found throughout the *Mysoor* country in the month of January; which is the proper time to gather it, that it may be dried for use. The frame of the instrument is rectangular, and is constituted of small square bars of brass or silver; perpendicularly to this frame and at one end of it a square plate is soldered, having a projecting edge to secure from injury the index that is to turn upon it: on the face of the plate a circle is engraved whose circumference is divided into 100 equal parts. The index, which is made of fine wire, and balanced as nicely as possible, is attached to one extremity of an axis of silver wire, which has liberty not only to turn, but to slide freely in the direction of its length

through double conical holes in two of the cross bars of the frame. This axis is extended to about half the length of the frame; and has a screw of 14 or 15 threads upon it formed by twisting tightly round it a smaller silver wire *from left to right:* the index is fixed at right angles to the commencement of this screw; and a loop and drop made of fine gold wire is so formed that when suspended from the axis it may slide along the screw with perfect freedom, and by the number of threads it runs over indicate the number of complete revolutions of the index. The end of the axis farthest from the index is conical, (enlarging outwards) and has a notch in it to receive one end of the beard of the *Oobeena Hooloo,* which may be confined there by the pressure of a sliding ring. The other end of the beard is fastened by means of a similar slit and ring at the farther extremity of the frame; this part of the apparatus being susceptible of adjustment by a screw.

By this contrivance the gradual expansion or contraction of the hygrometric substance will communicate a rotatory motion to the index, in such manner that while the graduated circle shews the divisions under a hundred, the loop and drop will indicate with equal precision the number of complete revolutions or of hnndreds on the scale. Thus, at the same time that the grass is superior to any other substance hitherto discovered for hygrometric purposes, the instrument makes 11 or 12 revolutions; whereas Saussure's makes little more than one revolution.

Mr. Kater recommends that all observations made with this hygrometer be reduced to what they would have been had the scale consisted of 1000 parts, or ten revolutions of the index: a circumstance which cannnot always be insured by the construction of the instrument, and the determination of the extremes of dryness and moisture. The whole apparatus may be made and fixed in a portable case of three inches long.

Observations.—We have no method (speaking individually) of ascertaining how far the substance now recommended by Mr. Kater is preferable for hygrometric purposes, to the horse-hair adopted by Saussure, or the whalebone of De Luc. But, taking this as a point which Mr. Kater has determined by comparative experiments, we cannot but admire the union of simplicity and accuracy in his apparatus: the mechanism is far simpler than in the hygrometer of Saussure; and may indeed be as well adopted when a hair or any kind of thread is the hygroscopic substance, as when the beard of *Oobeena Hoolop* is made use of. For our own parts however we cannot help apprehending, that this substance, although it may be preferable to horse-hair, is still in some measure ble to the objections made long ago by De Luc, who shewed that all animal or vegetable hygroscopic substances must, from their structure and organization, undergo *contrary* changes in the direction of their fibres from different variations of humidity. We wish success to every attempt to improve hygrometry; but we

fear the solution of its general problem is yet a desideratum; that we mean which consists in finding a true measure for hygrometric degrees, and in establishing the relation between such degrees, those of the thermometer, and the quantity of vapours contained in a determinate portion of the surrounding mass of air.

Farther Remarks on the New Transit Instrument. By Ezekiel Walker, *Esq.—Phil. Mag.* No. 108.

These remarks seem intended as supplemental to two former papers by the same author; one of which we noticed at page 165, the other at page 291 of our second voloume. Mr. Walker, who deals out his knowledge in driblets, now informs us that a small inclination east or west in the position of the plane on which the meridian line is drawn will affect the gnomon: and he therefore describes the following method of making this part of the instrument adjustible.

"Let a triangular stone, resting on three foot screws, be placed with one side facing the north, and the opposite angle pointing to the south; near the middle of this side the gnomon must be fixed to stand directly over the meridian line. Then, by means of these screws and a plumb-line suspended from the top of the gnomon, the right line which passes through the centres of the perforations may be readily set perpendicular to the horizon. The plumb-line must be suspended on the south side of the gnomon to pass over two dots, one made near the top of it, and the other near the bottom, in a line parallel to the line of perforations; and, as the plumb-line will not be in the way when observations are taken, it may always remain attached to the instrument."

Instead of observing when the limb of the solar image comes in contact with a line drawn on a plane surface, which is difficult on account of the penumbra, Mr. Walker recommends that lines be drawn so near together that the sun's image shall exceed in breadth the distance between three of those lines, because equal segments of the image on the exterior sides of such lines may be pretty readily ascertained by the eye. He is persuaded that the mean of five observations taken by this method would determine the time of the sun's transit over the meridian to less than a second with a gnomon only three feet high erected upon a stone three feet in length; in this case "it will be necessary to have seven lines drawn at equal distances; but the first observation must not be taken until the centre of the solar image be upon the second line, at which time the first and third lines will cut off two equal segments; when the centre comes to the third line, the second and fourth lines will cut off two equal segments; and the third, fourth, and fifth observations must be taken in the same manner. If these lines be drawn at such distances that the centre of the solar image may take about 54 seconds in passing from one line to another when the sun is near the equator, the five observations may be taken in less time than four minutes."

Description of the Optigraph, (Invented by the late Mr. RAMSDEN*) as improved and made by Mr.* THOMAS JONES.—*Phil. Mag.* No. 109.

MR. Jones's optigraph, which is intended to supply the place of a Camera Obscura, consists of a telescope, the principal part of which hangs vertically by means of gimbals or a universal joint attached to a horizontal arm that screws to the top of a vertical pillar, and is capable of being elevated or depressed at pleasure: the pillar is fixed at its lower extremity to the drawing-board by a clamp. The telescope, instead of being constituted of a single tube, is formed of two at right angles to each other; the rays from any object are received by a plane mirror placed above the telescope adjustible to a position nearly parallel to the object, and are thence reflected through the object-glass along the vertical part of the telescope, until they reach another plane mirror posited at an angle of 45°, which reflects them along the horizontal branch of the instrument to the eye-glass, and eye. Between the oblique speculum and the eye-glass, and exactly in the focus of the latter, a piece of plane glass is fixed, having a small dot in its centre. In continuation of the vertical branch of the telescope, and below it, there are sliding tubes, at the lower extremity of which a pencil is posited so as to slide freely without shaking; and near the bottom there is a convenient handle to regulate the motion of the whole apparatus. The telescope may be adjusted to a distinct vision by a milled head in its vertical branch.

In using this instrument, the upper mirror, &c. must have the position changed until the little dot in the horizontal branch appears, to an eye applied to the eye-glass, at the most convenient part of the field of view: then, a paper being suitably placed on the drawing-board to receive the picture, the apparatus may be so guided by means of the handle, that the little dot shall be brought in succession to correspond with every part of the landscape, or subject to be drawn, when the pencil will trace the required outlines. The size of the picture may be greater or less, merely by lengthening or shortening the distance of the upper part of the telescope from the drawing-board: the sliding tubes, &c. added for this purpose, constitute the improvement made by Mr. Jones.

Observations.—The author of this modification of Mr. Ramsden's instrument, (who resides in Mount-street, Berkeley-square,) packs up the whole in a convenient portable box. As it is, on the whole, one of the most ingenious perspective instruments, though liable to the objections we have in a former number made against them generally, we may bestow upon it the qualified commendation that in our opinion is alone due to any contrivance for such a purpose.

On Looming, or Horizontal Refraction. By EMERITUS.—*Phil. Journ.* No. 73.

THIS ingenious writer supposes the refractive density of a medium to vary gradually and equally in parallel strata; the variation beginning from a certain plane surface, and being continued, till, at a certain distance above that surface, (1666667 feet here assumed,) the refractive power wholly vanishes. Then, supposing a particle of light to be initially at rest in this medium, it will be actuated by a constant accelerating force, and by falling from the top to the bottom, it will acquire the velocity natural to light in the original medium: and if a ray of light enter the variable strata from the medium, its motion will be similar to that of a jet or a projectile rising in any direction from the bottom of a reservoir with the velocity due to its height.

Upon this hypothesis, Emeritus investigates the circumstances attending the motion and paths of several rays, which, diverging from a common point below the lower surface of a variable medium, enter that medium at such surface, and after describing parabolic tracks, emerge at the same surface, and proceed downwards obliquely. He then determines the condition under which the distance between the point of divergence, and that where the path of the lowermost ray intersects the horizontal plane passing through the former point will be a minimum; and shews from his geometrical construction, how, when the distance from the point of divergence to the lower surface of the medium is very small in proportion to the whole height of the medium, it may happen that there may be two images of an object, the upper of which shall be inverted; or under what circumstances the inverted image alone shall be seen. He likewise remarks, that, in some cases, when the variation of the medium is continued, in an inferior degree only, to the place of the eye and the object, effects of a similar nature may still be produced: and, in these cases, the curve indicating the density must be such, that the change of density, and consequently the curvature of the ray shall vary more rapidly than the distance from the line joining the eye and the object. And farther, that whenever the object can be be seen in its true place, beside the appearance of one or more displaced images, both the eye and the object must be situated in a uniform medium.

Observations.—It is perhaps impossible to convey a distinct idea of this ingenious writer's theory without diagrams; and this we are willing to excuse ourselves on the present occasion, because we trust Emeritus will pursue the subject farther. His theory is at present rather indicated than established: but as we are disposed to think better of it than of any other which has yet been advanced to account for the curious phenomena attending hori-

zontal refraction, we hope its author will fill up that which is now only an imperfect sketch, and furnish the public with a complete disquisition in which the theory shall be more satisfactorily proved, and applied to the illustration of the several phenomena mentioned by Messrs. Vince, Wollaston, and others. This is an undertaking the accomplishment of which would be both useful and interesting; and we must be permitted to say, it is an undertaking for which Emeritus seems extremely well qualified.

Problems on the Reduction of Angles. By T. S. Evans, F. L. S. *of the Royal Military Academy, Woolwich.—Phil. Mag.* No. 109.

These problems relate principally to the reduction of angles from one point or plane to another: and as they bear a near relation to both plane and spheric trigonometry, but cannot be considered as belonging to either of them separately, Mr. Evans classes them under the title of *Goniometry*.

Almost the only operations in which the problems solved in this paper will be of use, are those which are connected with an extensive admeasurement made for the purpose of ascertaining the length of an arc of the meridian, and the several degrees on such an arc; as has been exemplified in the trigonometrical survey carried on in England by Col. Williams, Col. Mudge, Mr. Dalby, and others; a work to which Mr. Evans makes frequent reference.

Now, in the first place all geodesic angles of elevation are affected by the horizontal refraction: Mr. Evans, therefore, describes the nature of atmospherical refraction, shews how the horizontal refraction may be found, and after informing us that Col. Mudge has taken it at $\frac{1}{12}$ of the contained arc, says, "as the instruments which this ingenious gentleman made use of were of the best kind and used with the utmost care, there seems to be greater reason to depend upon his results than those of any other person."

Mr. Evans next directs his attention to the problem of "resolving a triangle which has one angle very obtuse or very acute;" and then proceeds to the consideration of triangles in some one or more of whose angular points an instrument cannot be fixed; as when a flag-staff is placed on a church steeple, &c.

The remaining problems relate to cases in which one or two of the angles in a triangle are either below or above, or one below and the other above, the horizontal plane passing through the eye of the observer supposed at the third angle; and equations are deduced expressing the relations between the several angles, and thus facilitating the reduction to angles referred to the horizontal plane.

This writer then makes some remarks upon what is termed the *spherical excess*, in geodesic operations; refers to some convenient formulæ in Legendre's trigonometry, and to Cagnoli's trigonometry, a translation of which Mr. Evans has now ready for the

press; he adduces instances of the great accuracy of the survey conducted by Col. Mudge; shews how to avoid errors arising from objects being particularly illuminated by the sun; exhibits the relation between the height of a signal, and the greatest distance at which it is to be observed; lastly, he tells us, that the sides of the triangle must neither be "*too long nor too short*, in comparison of the length of the base," that the adjustments of the instruments must be carefully attended to, that in most cases, the consideration of the spheroid may be safely neglected, that the real places of the stations cannot be assigned by only knowing their distances, that no angles should be measured when the wind is high unless the stand or scaffolding is very firm, and that in taking a series of triangles, it is necessary to measure one or two bases of verification.

Observations.—As the principal investigations in this paper (which occupies 20 pages), are not susceptible of abridgment, we can only describe them in general terms, as above. But as the essay exhibits several peculiarities, it may be expected that we should make a few remarks upon them.

First, we object to the term *goniometry* on this occasion; principally because it has been applied by M. de Lagny in another sense, and is now generally restricted by mathematicians to that acceptation. The problems are in fact *trigonometrical*; for though they relate to angles, they are to the angles of *triangles*; and therefore require no new term for their designation. The subject of them is the same as engages the attention of the gentlemen concerned in the grand survey adverted to in the paper: and we dare say *they* will never run the risk of being pointed at for their affectation by calling theirs a *goniometrical survey*.

Secondly, Mr. Evans, in reasoning upon the nature of atmospherical refraction, and inferring that its effect is to augment the apparent elevation of objects above the horizon, omits the most important step: for all his reasoning stands for nothing unless it be likewise stated that the mind always refers objects to some place in the direction with which luminous rays from such objects strike the eye. It ought farther to have been stated that the English measurers, Williams, Mudge, and Dalby, found the horizontal refraction to vary from the 15th part of the included distance to the 9th part of the same, according to the different states of the weather and atmosphere, *one twelfth*, the estimate ascribed by Mr. E. to Col. Mudge, being the medium. Indeed Mr. E. would have done far better in this part of his paper, had he given a judicious summary of the labours of Simpson, Lambert, and Laplace, on this interesting topic.

Thirdly, with regard to Mr. Evans's own investigations, we must be free to remark that they are exhibited in a most uncouth and uninviting shape. The notation as far as we can decipher it (for some of it is needlessly obscure) is the notation of the

17th century; and the methods are most of them equally distant from the modern ones. The author must either have a very bad taste, or be very confined in his acquaintance with mathematical authors; otherwise we conceive he would have availed himself of the beautiful trigonometrical analysis introduced by Euler, and turned to such admirable account by some living mathematicians both in England and on the Continent. Such persons as are desirous to see problems of the kind now solved by Mr. Evans, and indeed all which relate to geodesic operations generally treated with elegance and perspicuity, would do well to peruse Mechain and Delambre's Treatise entitled *Base du Système metrique décimal; —Exposition des opérations faites en Laponie, pour la determination d'un arc du Meridian,* an admirable work by the Swedish mathematician Svanberg, with a masterly introduction by Melanderhjelm; and *Traitré de Géodésie,* par Puissant. We regret that we are not able to refer to any works of similar import with either of these in the English language; and that the attempt to supply the deficiency now under our notice, should leave us scarcely any room for commendation. There is, it must be acknowledged, a string of *truisms* at the end of the paper: but they are such as will be at once obvious to all who are qualified to engage in the practice of the problems discussed, and will not be an atom of service to any body else.

On a new Mode of equally tempering the Musical Scale. By Mr. John Farey.—*Phil. Mag.* No. 109.

Mr. Farey has discovered that 5 true *fourths,* when compared with 3 true *fifths,* and a true major *third,* or $\frac{5}{4}$ths — 3 V — III. give a wolf or difference, which agrees with the proper flattening of the fifths in *equal temperament,* to a surprising degree of exactness; the error being but of one part in sixteen thousand eight hundred parts of a comma! The practical application of this is obvious; but Mr. Farey intends to publish the farther details of this system at a future opportunity; when we may again return to it.

On the Stanhope Temperament of the Musical Scale. By Mr. John Farey.—*Phil. Mag.* No. 110.

This is a farther attempt at elucidating the Stanhope scale of musical intervals, by means of two other modes of notation. The first is by *tone major* ($\frac{8}{9}$), *tone minor* ($\frac{9}{10}$), and *hemitone* ($\frac{15}{16}$): the second is by the *Schisma* $\left(\frac{2^{15}}{3^8\,5}\right)$, *the less fraction* $\left(\frac{3^{37}}{2^{54}\,5^2}\right)$, and the *most minute* $\left(\frac{3^{84}\,5^{12}}{2^{161}}\right)$. The comparison is made in two tables, of which table I. shews the relations which the several notes in an

octave bear to the fundamental note C when tuned according to the Stanhope temperament. Table II. shews the relations of several other notes or intervals in the Stanhope Temperament, to the key note C. In both tables, the difference from the diatonic being shewn in the new notation by multiples or submultiples of *schisma* and *most minute*. And, for explaining various musical terms, which have occurred in a careful perusal of Mr. Overend's M. S. S. with Dr. Callcott's additions, Mr. Farey has prepared a third table, which is engraved and published in No. 112 of the *Philosophical Magazine*. But these tables are manifestly unsusceptible of abridgment.

A Letter from EARL STANHOPE *to Dr.* CALLCOTT, *being a Reply to Mr. Farey's Animadversions on the Stanhope Temperament.*

THIS letter is published in a pamphlet by Dr. Callcott, addressed to his Royal Highness the Duke of Cumberland: and it has been re-published in No. 110, of the *Philosophical Magazine*. Lord Stanhope begins by stating his reasons for dividing the scale of his monochord into 120 parts. "I chose (says he) the number 120 on purpose; because it is divisible *exactly* into *two thirds*, by the number 80; into *three quarters*, by the number 90; into *four fifths*, by the number 96; into *eight fifteenths*, by the number 64; and into *halves*, by the number 60. So that, if the length of the C wire be made equal to 120 equal divisions on the scale, the length of the E wire will be *exactly* 96 of those divisions, according to my temperament; that of the F wire will be *exactly* 90; that of the G wire will be *exactly* 80; that of the B wire will be *exactly* 64; and that of the C wire next above, will be *exactly* 60.

"Whereas, Mr. Farey, by injudiciously dividing his scale into 100 equal parts, instead of the proper number, which is 120, cannot express those important lengths *in round numbers*; but he is obliged to express the length of the G wire, by the number 66 on his scale, followed by the decimal fraction 66666 *ad infinitum*. In like manner he expresses the length of the B wire by the number 53 on his scale, followed by the decimal fraction 33333 *ad infinitum*. And this alteration he considers as an improvement!"

A considerable portion of his Lordship's letter is then employed in removing a supposed misconception of Mr. Farey's relative to the value of the C wolf, and the quint wolf. After extracting from his former essay, Lord Stanhope proceeds thus: "having explained in my treatise, the nature of the C wolf, in the C column; I then say, that "*there will be found an exactly* SIMILAR WOLF *in each of the other three columns*." That is to say, in the G column, in the D column, and in the A column respectively. This is accurate language. But, because the FOUR wolves in the major thirds, are SIMILAR to each other; Mr. FAREY seems displeased that I do not consider them as ONE.

" A half-guinea, a half-crown, a sixpence, and a half-penny, bear, *as moieties*, the same proportion and relation, to the guinea, the crown, the shilling, and the penny-piece, respectively. Yet, those FOUR first mentioned coins, although *similar* as halves, are not at all *equal*; though, according to Mr. Farey's mode of reasoning, they ought all FOUR to be considered as exactly ONE and THE SAME.

" In like manner, so little are those FOUR wolves *the same*, that they cannot exist even in the same column. They never can interchange places. Nature has (as it were) forbid them to meet in the same series; and they cannot be substituted for each other. For, the G wolf, for example, in monochord lengths, is as much smaller than the C wolf, as the G itself is smaller than the C.

" In my new temperament, I moreover divide those FOUR wolves *differently*. For in the C and G columns, I distribute them in *one* way; as appears by my *musical memorandum table*, in page 22. But in the D column I distribute them in a *second* way; and in the A column I distribute them in a *third* way, which is different from either of the former. And I should like to ask Mr. Farey, *what a strange sort of tuning* it would be, if I were to consider those FOUR distinct wolves as ONE only, and therefore distribute them *alike!!!*

'A very radical defect (says Mr. Farey) in the application of the *Stanhope Temperament* to practise, as directed by his Lordship, now presents itself in the mistake made in suppposing that *equal temperaments* of two successive *thirds*, or of three successive *fifths*, effected by means of *geometric mean proportionals* interposed between the extremes in each case, and on which all his Lordship's calculations are found to be grounded, (and to agree very exactly with my calculations upon the same principles), produce "*equality of the beatings*," by which, says his Lordship, "equal *deviations from perfection*" may be correctly ascertained.'

" Mr. Farey does here distinctly admit, that *my* calculations agree exactly with *his*, so far as I use my method of *geometrical mean proportionals*, to determine correctly the *bi-equal* thirds, and likewise the *tri-equal* quints. But he imagines that he has found out a very radical defect (as he calls it) in my other mode of obtaining those same major thirds and quints; viz. by means of the "*equality of the beatings*," between such thirds, when compared to such equal thirds; and also between the equal quints respectively. Mr FAREY's radical mistake seems to consist in this; namely, that he does not understand the *scientific terms* which I have been obliged to use; and that he does not even know the clear and wide difference which there is between "BEATS" and "BEATINGS."

" BEATS, as applicable to this subject, are nearly synonymous to *vibrations*. For each *vibration* produces ONE BEAT against the air. So that, when, for example, a proper musical string is shortened, the *vibrations* increase in number *inversely* as the

length of the string; and the BEATS increase, of course, in the very same proportion. If the longer string be, for instance, the note C, that shorter string which will yield the precise sound of the *perfect octave* C next above, will produce, in any given time, exactly *twice* the number of BEATS that were produced by the longer string. So that, in this case, we have *two* distinct sets of BEATS, but there are NO BEATINGS whatsoever. For there are never any BEATINGS in any case, when either an octave, a quint, a fourth, or a major third, is *quite perfect.* And it is precisely from the *absence* of the BEATINGS (as they are technically called) that we know that the particular musical interval then under examination is *perfect.* In like manner, in a *perfect unison* there are NO BEATINGS. But, in this case, as in the former, there are *two* sets of BEATS; although, from the *isochronism* of the vibrations of the two strings in unison, (that is to say, from the equality of the number of their respective vibrations in equal times), those *two* sets of BEATS appear to the ear nearly as if they were but *one.*

"But, if a unison, an octave, a quint, a fifth, a fourth, or a major third, be made a very little *imperfect,* then we instantly perceive a *slow* BEATING, which is a *third sound,* completely distinct from either of the *two* sets of BEATS above mentioned. The BEATING (as every one, except Mr. Farey, well knows) *increases in quickness,* as the imperfection increases. And it is only by means of the comparative quickness or slowness of the BEATINGS, that the exact *degree of the imperfection* of any musical interval can be ascertained by the human ear."

Observations.—These lovers of harmony seem likely to strike some very *discordant* notes, while animadverting upon one another's compositions; and we are fearful there is more probability that the disputants should heat each other's tempers, than improve this department of science by the present state of their controversy. Instead of abridging Lord Stanhope's Letter to Dr. Callcott, we have thought it better to extract the most important parts in his own words, that we might not unintentionally misrepresent his arguments: we think he has detected an error in Mr Farey's strictures; but we by no means conceive his answer to these strictures so "*triumphant*" as Dr. Callcott seems to imagine.

Lord Stanhope, when comparing the respective advantages of dividing the monochord into 120 and 100 equal parts, loses sight altogether of the logarithmic method of expressing the musical intervals; and, at the same time, he pays no regard whatever to the observation of Mr. Farey, that "musical intervals are that peculiar species of magnitude which cannot be numerically defined by the *length of the strings* which yield the sounds." The noble Lord should have recollected that the logarithms of the circulating decimals he specifies, or of their equivalent vulgar fractions, are as easily obtained as those of $\frac{1}{2}$, $\frac{3}{4}$, &c. while the loga-

rithms measuring the ratios are more readily compared, when the unit is divided decimally than when it is supposed to contain 120 equal parts. Again Lord Stanhope appears to exult, though in a jocose manner, over Mr. Farey, for confounding the meaning of *beats* and *beatings*; and thinks that what he has said will be quite sufficient to *beat* him out of his error, and to *beat* into him the truth. But his Lordship should have recollected, that both Dr. Smith and Dr. Robinson, confessedly the best writers on the philosophical theory of musical sounds in the English language, use the terms *beat* and *beating* as synonymous; and therefore, when his Lordship uses one of these terms in a sense different from that to which it has been confined by standard authors, if the readers of his essay misunderstand his meaning the fault is not in them, but in himself, for appropriating an old term to a new sense without sufficient caution. It is true the term *beat* is generally used by practical musicians, to designate a transient grace note struck immediately before the note it is intended to ornament, and lying a semitone beneath it; but this is an acceptation, which is sufficiently precluded on the present occasion by the essential distinction between the theory of sounds and the practice of music; but, as to the sense in which the term is used by Earl Stanhope, being determinable by the vibrations of the elastic chord, and analogous to that in which persons speak of the vibrations of a clock pendulum as *beats*, it has, we presume, much more the cast of a vulgarism than of an appropriate technical word free from ambiguity and descriptive of the thing signified and nothing else.

Instrument for ascertaining the Strength of Gunpowder.—Sonini's Journ. or Repertory of Arts, No. 63, New Series.

In this instrument a small barrel is placed vertically to hold the powder, over which a stopper is held down by a weight suspended beneath it by a cord.

The stopper is connected with a vertical ratchet wheel, with thirty teeth cut on its circumference, against which a spring catch presses; on the edge of the wheel a groove is cut to hold the cord by which the weight is sustained; a small pan for the priming projects at right angles from the barrel.

The face of the ratchet wheel is graduated with about 50 divisions, beginning from its lowest point, and the numbers ascend at the opposite side to the weight; the mark for good powder is about the 13th degree, and when the explosion forces round this mark to the catch, the powder is known to be of the quality desired; but for the greater precision, the trial is repeated several times, and the mean term taken. The apparatus described, is attached to a handle, by which it is held when discharged.

In the powder-provers generally used, a coiled spring acts instead of the weight above mentioned; and the principal advantage of the

new instrument ari es from its action being always uniform, while that of the old one varies, on account of the spring losing its elasticity from long continued tension.

Observations.—It is rather singular that M. Regnier takes no notice in his present communication of his former invention of an eprouvette or powder-prover, published in *Memoires explicatifs du Dynanometer et autres machines inventees par C. Regnier.* An. vii. In that publication he adverted to the inconveniences of the old powder-prover, on whose incorrectness he now likewise descants; and then describes one in which he fitted a small brass cannon (such as the children play with) to one branch of an ingenious spring-weighing instrument, fitted with an index, being a piece of cloth or of leather sliding along a wire adjusted parallel to a graduated arch, and a stopper or cap to the muzzle of the piece. Then, as the powder occupies a greater space by its inflammation, it drives back the stopper, and the latter carries with it that branch of the instrument in which its tail is fastened: and that branch cannot remove with respect to the other, which is made to move also by the recoil of the little cannon, without driving before it the small index piece, which, remaining at the place to which it is thus driven, shews the comparative strength of the powder. Here the only friction in the instrument is that of the small cloth index upon its wire, which is exceedingly minute compared with that of teeth and pinions, and on the whole we prefer this, as a portable measurer of powder for sportsmen, &c. to what M. Regnier now describes, or indeed to any in use.

Account of the Report of the Committee of the House of Commons, appointed to consider the State of the Woollen Manufacture of England.—Abridged in Repertory of Arts, No. 61, New Series.

The attention of Parliament was not called to the woollen manufacture in consequence of its decay, for it has been gradually increasing, but in consequence of disturbances in Wiltshire and Somersetshire, arising from an attempt to set up a gig-mill, which the workmen contended was prohibited by an ancient statute. The ancient laws respecting the woollen manufacture being examined, it appeared that various penal laws remained unrepealed, which, although they had become obsolete, were threatened to be put in force against those masters who were obnoxious to the workmen. Accordingly, petitions were presented to the house by the master clothiers, and counter petitions by the workmen, and, of course, the house appointed a committee to consider the allegations on both sides, and, in the mean time, a temporary suspension of the penal laws was adopted.

The acts relative to the woollen manufacture are 70 in number; hose for regulating the conduct of masters and workmen, and for

preventing frauds and embezzlements by journeymen and others are, as well as those for preventing the exportation of certain materials and implements, wise and salutary.

The acts which control the manufacturers in the making and selling of cloth, more particularly those which prohibit the use of certain articles of machinery, are numerous. Their general object is to provide against the use of articles, or processes, which might be injurious to the quality of the cloth. Other acts exhibit traces of a jealousy of the manufacturing, in favor of the landed interest. Many of these statutes had been amended, and in part repealed, soon after their enactment, and the remainder had sunk into oblivion, and had been considered as obsolete.

Great differences of opinion have prevailed, with respect to some of these statutes; evidence was given on one side to shew the injurious effect of the gig-mill and shearing-frame, while merchants and manufacturers of the highest credit, and of the greatest experience, proved that they finished the cloth in the most perfect manner, and in one foreign market, the cloth has been expressly stipulated to be dressed by the gig-mill. Alarms similar to the present, existed at the introduction of several of the machines now in general use; but these alarms have died away, and the use of the machines does not appear to have lessened the number of the workmen. The system of patents, by which the inventor of any new machine secures to himself the exclusive benefit of his discovery, for a certain term of years, provides, in most cases, against its too sudden and general establishment.

If the principles on which the use of these particular machines is objected were once admitted, it would be impossible to define the limit, or to foresee the extent of their application, and if Government had acted on such principles 50 years ago, the woollen manufacture would never have attained to nearly its present extent. It is above all, by the effect of machinery in improving the quality and rendering the fabrication of our various articles of export, that, notwithstanding the accumulation of taxes, and the increased price of things which of course has a considerable effect on wages, our commerce and manufactures have increased to their present height. Our neighbours are intent on improving their manufactures, and on extending their commerce; their attempts to this end would be favored by our throwing any obstructions in the way of enterprise and ingenuity, and the free application of capital, or by our prohibiting any machines, which would infallibly find their way into foreign nations; for this reason, the repeal of all statutes, prohibiting the use of particular machines, is desirable, as well as of those controlling the making and selling of cloth, except only those which prohibit its exportation in an unwrought state.

There are three different modes of carrying on the woollen manufacture; that of the master clothier of the west of England, the factory system, and the domestic. The merits of the domestic

system is great, but the apprehensions entertained of its being routed out by the factory system, are at present, at least, wholly without foundation; for the merchant finds his interest and convenience promoted by the domestic system, in being able to carry on his trade with far less capital than if he were to manufacture all his cloth at home. The quantity of cloth manufactured by the domestic system, has increased immensely of late years, not only in itself, but as compared with the quantity made in factories. The owners of factories are often among the most extensive purchasers from the domestic clothiers, and are thus enabled to apply a much larger proportion of their capital to the manufacture of fancy goods, and any articles of a newer, more costly, or more delicate quality, in their factories, so that the two systems mutually aid each other.

As the manufacture is carried on with no less skill, in places where persons are employed who have not served regular apprenticeships, it does not seem necessary to render apprenticeships compulsory, but it would, at the same time, be improper to prohibit them absolutely, or by rendering them illegal, to prevent their being entered into.

The operation of the stamping acts is more suitable to the north of England, whereby much the larger part of the manufacture is sold in a crowded market, than to the west of England, so that as to the latter, they ought to be repealed.

In the course of these inquiries, some circumstances came to the knowledge of the committee, relating to the institution, or society of clothworkers, or shearmen, whereby it appears, that the society originally instituted for the relief of the sick, is now diverted to very different, and it is highly to be suspected, very reprehensible purposes. The least evil to be apprehended from these societies, is the progressive rise of wages, which cannot fail to accomplish the ruin, not only of any particular branch of trade, but even of the whole commercial greatness of this country. As these societies are still more alarming in a political view, the existing laws against illegal combinations, deserve the most serious consideration of Parliament.

Account of the Report of the Committee of the House of Commons on Acts regarding the Use of Broad Wheels, and other Matters relating to the Preservation of the Public Roads.—Abridged in Repertory of Arts. No. 64, New Series.

One of the first objects which the committee took into consideration, was the great danger to which travellers are exposed, from the overloading of stage coaches, and the excessive number of outside passengers that they carry, (which has often been known to amount to twenty-four), and the extreme injury done to the roads, by such great weights being carried by those vehicles

on narrow wheels. In consequence of their report on this subject, an act was passed in June, 1806, (which took place in the following September,) limiting the number of outside passengers to ten in winter, and twelve in summer, and restraining the packing of luggage on the roof to the height of two feet; and containing many salutary regulations for the conduct of coachmen and guards to the passengers, and to their employers.

The opinions of the committee relative to carriages chiefly regard the formation of the wheels and axles; on this subject they requested the assistance of Mr. Cummings, of Pentonville, whose ingenious and accurate experiments on wheel-carriages, may be seen in the thirteenth volume of the Repertory of Arts.

Mr. Cummings repeated his experiments before the committee, and proved to their satisfaction the *great superiority of cylindrical wheels, and of straight axles,* on well formed clean roads, and their beneficial effect in consolidating them; and also demonstrated the very injurious effect which conical wheels have on roads, in grinding their hardest materials to powder, in deranging them, and in leaving their surfaces in a state most liable to imbibe water.

The committee express their strong approbation of Mr. Cummings's conclusions; and think that much benefit might arise from his investigating other circumstances relative to wheel-carriages, and illustrating them by experiments in the same manner that he has done those recited.

On the position of *Spokes,* the committee are of opinion, that when they are placed in two rows on the naves, and are dished in opposite directions, they form the strongest wheels; and that this arrangement of them is particularly well calculated for wheels whose rims are of considerable breadth.

They think more experiments are necessary to determine the precise limits of the *breadth of wheels*; for though on hard well made roads, great breadth is advantageous, if the wheels are made cylindrical and the axles straight; yet, in deep snows, deep sludge, or deep roads in general, a narrow wheel will not make so much resistance as a broad one: for this reason they do not think proper for the present to recommend a greater breadth than from nine to twelve inches; though it should ever be held in remembrance that the narrower the wheel is, the more damage it does the road, and that the broader it is, if cylindrical, the more it improves them.

Of the *height of wheels* they do not express a decisive opinion, but seem however inclined to approve of low wheels, on account of their lightness and peculiar advantages in going over hills, especially as the general good state of the roads makes the advantages which high wheels possess in going over obstacle, no longer of any importance.

They recommend *straight axles* in preference to those bending downwards; and particularly disapprove of those which bend forward as well as downwards at their extremities.

They are of opinon that the *loads* which *four-wheeled waggons* are now legally allowed to carry, so much exceed what they ought to be, that *scarcely any materials of which roads are formed can bear their enormous pressure.* They acknowledge the advantage which arises to their owners from the saving of man's labour in their use, as they require so few attendants in proportion to the number of horses requisite for them, and to the burdens which they carry; but think they cause a heavy expense to the public, from the great destruction which they occasion to the roads, and which they think is in a great measure owing (in addition to the above cause) to the broad conical wheels. These they greatly condemn for the reasons before stated.

They approve much of *single-horse carts,* especially in situations where one person can take charge of three or more of them at the same time; and think that *by no other means can so great a quantity of goods be carried at so small an expense.* The wear of the roads being of course taken into the computation.

They think favorably of the suggested use of *carts, with three horses abreast* for hilly countries, as the horses can thus be made to draw all together in going up hill, and to bear equally the weight of the carriage in its descent down hill: and they recommend their use particularly for the ordnance and military departments, provided their wheels be of a breadth proportionate to the loads which they are to carry, and are made of a cylindrical form and with straight axles.

They are of opinion that the *weights,* settled by act of parliament, to be carried in proportion to the breadth of wheels, require new regulation. A series of resolutions on this subject, proposed for adoption, are annexed in the appendix to their report.

They think decidedly that the *laws relative to high-ways* and turnpikes, require to be re-considered: and are inclined to be of opinion, that it would be advisable to repeat all the former laws relative to them, and form the whole into one digest.

They think a complete set of *experiments* well conducted, and continued for a considerable time in situations calculated to produce results which might be relied on for their accuracy and universality, should be tried relative to the form and draft of wheel-carriages.

They notice in the course of the report, the Rev. *Mr. Milton's patent coach,* contrived so as to be much less liable than others to overset, but do not give any opinion on the merits of the invention; an account of this coach may be seen in the ninth volume of the Repertory of Arts, page 172, or in page 376, vol. II. of the Retrospect.

They mention the *Commercial-road* to the West India docks, with much commendation as a model for other roads; the centre of which road is paved of a fit breadth for heavy carriages, and its sides constructed in the usual manner, for the use of light carriages and horses.

They express their decided approbation of *iron rail roads*, as being in many instances preferable to canals, and think them likely to come into more general use: some notice is also taken in the report of a project for forming what may be called *stone rail roads.*

The *direction and levels of roads* they also conceive to merit the attention of Parliament; and are of opinion that most roads might be much improved by alterations in these particulars, and recommend the first experiment of such alterations to be made on the great line of road between London and Edinburgh.

The committee, in concluding their report, recommend all these different objects to the serious attention of the house in the strongest manner, by stating them to be of infinite consequence to the convenience, comfort, commercial prosperity, and personal security of their fellow subjects.

Resolutions were suggested to the committee by a member, for promoting the better preservation of roads as far as regards the regulation of weights, which appear to have been formed with much knowledge of the subject, and will doubtless be well considered by future committees.

Observations.—It is much to be hoped that the many excellent remarks, which the committee has made on the subjects recited will enlighten the public mind on these matters, as well as lead the way to those salutary regulations respecting them, which we may now expect from the wisdom of Parliament.

The manner in which even the acts last passed, relative to stage coaches, are evaded, should excite careful attention to make the next binding; we believe proprietors of carriages would very readily relinquish the use of conical wheels, did they know that it costs considerably more to draw goods on such wheels, than on those whose rims are cylindrical and axles straight, and that it probably would be no exaggerated statement to say, that in waggons their use causes an addition of one horse in eight.

The only objection to broad cylindrical wheels is, that in deep sloughs the mud does not escape so fast laterally from them, as from narrow wheels, or those rounded transversely at the tire: but do roads in such a state deserve such consideration, that all the good roads in the kingdom should suffer incessant injury to accommodate carriages to their neglected condition? and would it not be more just and wise to compel the parishes where such roads are, to keep them in a proper state? or to do so at the expense of the nation, than to suffer so much loss on account of them? where proper materials for roads are extremely scarce, we may without risk venture to say that public iron rail roads would in such places cost the nation much less than the expense of forcing heavy goods through tracts of tenacious mud, or courses of deep sand which do not deserve the name of roads.

It perhaps might be wise that the new act should not entirely confine the conveyance of goods to carriages with broad wheels, and that it might admit the option of increasing the number of wheels in proportion to the weight carried, as it is demonstrable that eight wheels each three inches broad, will carry the same load, with as little injury to the road, as four wheels each of six inches breadth, with the additional advantage of being free from the objections urged against broad wheels; to make the regulations in the new act, (for the breadth of wheels proportionate to the load carried,) relate to the sum of the breadth of all the wheels, without specifying the number used, but to leave that to the option of the proprietors of carriages. Thus if the regulation were worded, that to carry six tons the breadth of the wheels used should be in all 36 inches; it would much simplify the business, and carriage-owners would have it in their power to chuse whether they would carry that six tons on eight wheels of four inches breadth, on four wheels of nine inches breadth, or on two of eighteen inches; but every encouragement should be given to increase the number of wheels in proportion to the load, for the preservation of the roads, as there is much less opportunity of evading regulations for the benefit of roads with them, than with few wheels; for instance if two wheels each of eighteen inches breadth were used, they might be so rounded transversely at the tire as to press a hard road in but two small points; but eight wheels, be they shaped in any curvature transversely, must give eight different points of support to the load carried, and diminish the chance of injury to the road in a fourfold proportion. The approbation which the committee most deservedly give to iron rail roads, suggests the propriety of granting parliamentary encouragement to their use. It would be perhaps a good measure to permit private companies to construct them along each side of the public high-ways, when broad enough to admit the small portion necessary for this purpose to be occupied, (which need not be more than eight feet in all, or four at each side,) and even this portion could not be said to be entirely separated from the high road, as it would still be subject to common use for horsemen, foot passengers, cattle, and some kinds of carriages, besides those peculiarly constructed for the rail road; no measure could, we think, tend more than this to preserve the high-ways or to diminish the expense of the conveyance of goods, the great importance of which objects to the public prosperity, the committee have declared in the forcible manner which concludes their report.

A new Method of Ascertaining the Rate of the Velocity of a Ship under Sail. By Mr. J. W. Boswell.—*Repertory of Arts*, No. 61, New Series.

The contrivance which Mr. Boswell now proposes is founded upon the well known proportion subsisting between the resistance

experienced by a body moving through a fluid, and the velocity of its motion, the former being as the square of the latter. Hence let a common log, or instead of it an instrument formed of a stick like a walking stick with four or more sheaves attached to it at about a foot from each other, or instead of the sheaves any flat pieces of board similarly posited, be thrown into the water and drawn after the ship by a cord, attached to a spring steelyard (or other suitable weighing apparatus) fixed at or near the centre of the oscillatory motions of a ship; then will the scale of the weighing instrument so fixed indicate changes that vary as the square of the velocity of the vessel, or of the implement drawn after it.

The actual weight corresponding to some assumed velocity of the ship's motion is to be ascertained by a series of experiments, in which the log might be used; and then tables may be readily computed for the particular apparatus adopted, by which any other velocity may be determined from the weight on the steelyard, &c. by inspection. And as the resistance of the floating implement may be varied at pleasure by altering the size of the disks, it is recommended to modify it so as to raise a *square* number of ounces in the standard experiment, since that expedient will facilitate the computation of the table.

The line let out must be so long that the instrument may not be irregularly affected by the motion of the waves; and the accuracy of the whole will be increased by wetting the line before it is thrown out. The original length of line in the standard experiment must of course be retained.

Observations.—The author of this ingenious contrivance, whose mind is always fertile in the invention of expedients for important purposes, has our thanks for devising a method of ascertaining a ship's velocity, which we think preferable to any of the methods described at pp. 318—319, of our second volume, as well as to the Marine Surveyor of De Saumarez, described in vols. xxxiii, xxxvi, of the *Philosophical Transactions*, and probably to the spiral logs of Russell and Foxon. His apparatus has the advantage of indicating the variations of a ship's motion at every instant of its passage, in a much more simple manner than any perpetual log with which we are acquainted. But we must be permitted to doubt whether the rate obtained by this method will have all the accuracy that might be wished: for 1st. If the standard experiment is to be made by comparison with the log, many of the errors accompanying the use of the log must necessarily accompany the result of the experiment, and be proportionally incorporated with every other velocity. 2dly. If the experiment be made independently of the log, as it might be with tolerable accuracy while the vessel is sailing down a river; still as the specific gravity of the water in the main sea is not exactly the same as that in a river, and the resistances vary with the densities of the fluid, there would here be a source of error against which

it would not be easy to guard. 3dly. If the water of two seas, for example, the Mediterranean and the Atlantic, be of different densities, as has been lately asserted, a standard deduced in one will not apply to the other. And 4thly, Since the resistances are not exactly, but only *nearly* as the square of the velocities, the hypothesis assumed is inaccurate. These sources of error when considered in the aggregate, must surely prevent us from placing any great dependence on the correctness of the general result, ready as we are to acknowledge the ingenuity of the contrivance.

REVIEW OF SPECIFICATIONS OF PATENTS,

PUBLISHED IN THE REPERTORY OF ARTS, &C. IN THE MONTHS OF JULY, AUGUST, AND SEPTEMBER, 1807.

Mr. Samuel Phelps' *Patent for a Method of making Vegetable and Mineral Alkali. Dated June* 1806.—*Repertory of Arts,* No. 62, New Series.

Mr. Phelps' method of preparing alkali consists in slightly drying the vegetables from which it is to be procured; in mixing them with straw, light dung, or hay, to give tenacity to the mass; and then forming them into stacks, and thatching or covering them in any other mode, to defend them from the rain. In this state the whole is to lie till it has passed through the putrid fermentation; after which it is to be burned with wood, or other vegetable fuel. Towards the end of the operation the fire is to be raised so as to fuse the saline residue.

The plants to be used for the production of mineral alkali are kali, salicornia, or sea-wrack; and for the vegetable alkali fumatory, worm-wood, or heath.

In wet seasons, the rain washes off the alkali that exudes from the plant, and causes the product to be much less than it otherwise would be. Mr. Phelps declares his method of stacking the plants, and making them undergo the putrid fermentation, prevents a waste of the alkali, and that the whole method of management proposed by him, will cause a greater produce of alkali from a given quantity of plants.

Observations.—It has been long known that vegetable alkali was contained in the drainings of dunghills; and Mr. Phelps is, we believe, the first who has proposed the use of the putrid fermentation in procuring this substance.

Those who feel interested relative to the various means of procuring alkali, will find some curious information in Glauber's work on the Prosperity of Germany, where he treats of the means of producing nitre. He mentions some stones which contain it;

and since that time many more have been discovered; if any cheap method could be contrived to obtain it from them, it would be a most valuable invention.

Mr. ELIHU WHITE'S *Patent for a Machine for Casting Types, &c. for Printing. Dated October,* 1806.—*Repertory of Arts,* No. 62, New Series.

THIS machine is composed of a number of small pieces of metal of the same breadth and depth as the types wanted, so placed in a strong metallic frame, that every second piece can be drawn between the others, so as to leave a vacant space equal in its dimensions to the type required.

The metallic frame consists of a sliding part, and a fixed part; the sliding part is formed so as to move very truly and steadily; and is drawn forwards and backwards by a strong screw attached to its centre, which is turned by a winch.

Of the the small metallic pieces every second one is attached to the sliding part of the frame, and the others lie between them; the first are called female sliders and the latter male sliders.

The male sliders are an inch shorter than the others, and have each a stud or pin projecting from it, half an inch in height, which serves to regulate the extent to which it can be drawn backwards; a grooved bar is fastened across the fixed part of the frame, which stops the studs; and the degree of their distance from the part of the frame opposite to their other ends, is regulated by screws fixed in this bar before each of the studs. By this arrangement when the female slides are moved forwards, the male slides move with them till they are stopped by their studs coming against the bar, after which the ends of the female sliders proceed on beyond them to the end of the fixed frame, and thus form the vacant spaces before-mentioned, which are then equal to the distance that the female slides have moved beyond the males.

A bar perforated by a groove, which forms a sort of trough, is placed beneath the cavities thus formed: this is called the matrix bar, and is moveable on hinges or pivots, in such a manner that it can be removed at pleasure, to take out the types. Into the groove of the matrix bar is fitted a metallic box, or long cell, capable of holding as many matrixes as the machine will form letters at a single cast; the matrixes may be fastened in the box either by screws, wedges, or other means; and when the types are to be cast, the matrix box is pressed up against the sliders, and will then bring the matrixes exactly opposite the vacant spaces between the sliders.

A trough formed of two pieces is placed above the cavities, to convey the melted type metal to them; one half of this trough is attached to the fixed part of the frame, the other to the sliding part; so that when this last part is moved forward, the trough is completed by its parts coming in contact; but when it is drawn

back the trough separates; and at the same time the female sliders are drawn within the male's, which leaves the newly-cast types quite clear of all the sliders, so that they easily drop out.

Observations.—This machine seems strong, steady, and well contrived for its purpose. The screw, besides moving the sliding part forwards and backwards, as mentioned by the patentee, serves also to compress the ends of the female sliders sufficiently tight against the fixed frame, to prevent the fluid metal from running out. Though the friction of the slides against each other must ultimately damage them, yet if well made they will last a long time, and may be easily replaced when worn out.

Mr. William Cubitt's *Patent for a Method of equalizing the Motion of the Sails of Windmills. Dated May,* 1807.—*Repertory of Arts,* No. 62, New Series.

Mr. Cubitt's patent might have been entitled, a patent for a substitute for sails of windmills of which the surface can be varied in proportion to the wind, instead of one for equalizing the sails, for properly speaking, Mr. Cubitt uses no sails in his method; but thin flat boards, called valves, are suspended by hinges across the arms of the windmill, like the weather boards of the windows of corn stoves, which, by short levers, are connected to a bar that runs parallel to the arm of the vane; and that bar, by other levers, placed in different directions, is so joined to another bar, which passes longitudinally through the centre of the shaft, that when it is moved forwards to its furthest extent, the valves lie flat; and when drawn back, they stand up, either at right angles to the arms, or at some less degree of inclination proportional to the retraction of the bar. The end of this bar farthest from the vanes, turns in a ring, to which is attached a rack, moved by a pinion, that is turned round by a rope, whose ends are united, which descends within the reach of the miller; who by drawing it in the proper direction, can regulate the degree of the angle which the valves form with the arms, and thereby determine the quantity of surface they oppose to the wind. Mr. Cubitt describes another method of causing the bar, that passes through the shaft, to move the valves; in which it terminates in a rack, that turns a pinion, which acts on another long rack, that runs along the arm, and operates on segments of toothed wheels attached to the valves, so as to give them the inclination required.

Observations.—The last method mentioned of moving the valves, would be much more expensive than the first, and add a consider-

ably greater weight to the vanes, we have therefore not described it very particularly.

The first method has some merit, but it is not a new invention; a model of a windmill, fitted up in this manner, made of copper, has been exhibited among the collection of models of the Dublin Society for more than twenty years, and probably is still among them: as this model had a singular appearance from the materials of which it was composed, it is likely that most who have viewed the society's collection will recollect it.

Mr. JOHN ROEBUCK's *Patent for certain Improvements in a Machine called the Caledonian Balance. Dated May,* 1807.—*Repertory of Arts,* No. 64, New Series.

THE Caledonian balance will be most speedily comprehended by considering it as a miniature representation or model of the apparatus for weighing waggons, constructed at most turnpikes in England. In both a platform pressed down by any heavy body laid on it, is so connected with levers and balances, turning on centres, that its weight may be easily ascertained by moving a sliding counterpoise along a graduated lever, constructed like that of a Roman statera or steelyard, until the latter balances the former.

Mr. Roebuck's improvements on this instrument consist, first, in fixing a weight beneath the axis of the above-mentioned graduated lever or statera, which he says will render the equilibrium in the horizontal position more smart, speedy and effectual. Secondly, in some constructions he uses the action of a spring instead of the counterpoise, which shews the weight of the load on the platform, by a graduated scale. Or thirdly, he places beneath the axis of the statera a weight attached to an arm, forming an obtuse angle with that of the statera; by means of which, on the principle of the bended lever, the re-action will be greater the lower the platform descends, and the weight of the load may be ascertained by the motion of the added arm along a graduated vertical arc. Or fourthly, he fixes a scale to the counterbalancing arm of the statera, and weighs the load on the platform by a set of weights in the usual manner. Or fifthly, he reverses the position of the graduated arm of the statera, so that it shall pass beneath the platform, instead of projecting from it, and at the same time reverses the situation of the other balancing arms and levers, to correspond to that of the statera; by which the instrument will be rendered more compact.

Observations.—The Caledonian balance appears from the account of it in the specification, to have been an invention some time in use; and Mr. Roebuck's patent only relates to what he terms improvements on it.

We cannot speak in praise of these improvements, in which we see no advantage in the mode of weighing over common balances and steelyards, and the machine is much more complicated than any of them; of course is more liable to derangement and imperfect action, and is also considerably more costly.

Mr. WILLIAM SHOTWELL'S *Patent for Machines for Washing Linen and other Articles, and which are applicable to divers other Purposes. Dated April,* 1807.—*Repertory of Arts,* No. 62, New Series.

THE first washing machine described in Mr. Shotwell's specification, consists of a water tight box, about three feet and an half in length, and fourteen inches in width and depth; in which a flat piece of wood, perforated with holes or grooves, called a compresser, placed transversely and vertically, is made to move backwards and forwards, by an horizontal lever, which communicates with it by a handle that rises upwards from it through an oblong space of about an inch broad, left between the two lids which form its cover, one of which lids opens on hinges to admit the clothes.

The compresser may also be made to slide on ledges fastened at each side of the box near the top, and may be put in motion by an horizontal pole fastened to it, and passing through a hole in one end of the box, to an horizontal lever, that impels it backward and forwards. The cover for the box in this last method, may be made with one entire surface. At the internal angles of each end of the box sloping pieces are fastened, to cause the linen to turn round as it approaches them. This machine may also be used as a churn.

The other washing machine is formed, in every respect, like a barrel churn, having longitudinal ribs attached to its inside, and a hole cut through its side large enough to admit the clothes, and covered with a square stopper fastened with a staple and bar. Instead of ribs, smooth wooden pins may be fastened to the inside of the barrel for the same purpose; but in either case all angles are to be carefully rounded off, and all splinters to be removed. This last apparatus, the patentee proposes as an improvement on Beetham's washing machine, and on all others where axles are used.

Two other articles are introduced into this patent besides the washing machines. The first of which is a plan for friction rollers, in which the rollers are inclosed loosely in an hollow case round the axis, and are prevented from dropping out by the ends of the case, or by a rib of about an eighth of an inch deep, projecting from the inside of the case, made to fit in cavities cut round the rollers to correspond to it.

This case is made rough outside, and the cavity into which it is to be placed being made rough inside, a mixed metal composed of 25 parts pewter and one part regulus of antimony, is to be cast between them, to fasten them together, which the patentee mentions as a new invention.

The other contrivance proposed by the patentee, is to heat water or generate steam by passing a pipe through a fire, one end of which communicates with a reservoir of cold water, and the other end with the washing machine.

The patentee also proposes to use the second washing machine, or the revolving barrel, as a condenser for a steam engine; for which purpose it is to be formed of thin metal, and is to revolve in a vessel of cold water, which is to cover as great a portion of its external surface as may be thought proper.

Observations.—The first machine is evidently an imitation of Beetham's patent washing machine, constructed on much worse principles wherever it varies from it, and very inferior to it in most respects, particularly in the want of the elastics bars, by which Beetham's compresser is suspended.

The second washing machine, the revolving barrel, we are much inclined to think, would have little or no effect in cleansing linen put into it; its use as a condenser for steam, might be more effectual; but while it would be much more complicated than the common condenser, no advantage appears in it to compensate in the least for this defect.

The mode of applying friction rollers mentioned by the patentee, has no advantage over a very old contrivance which has been often practised: a model of which, on principles nearly similar, made more than 50 years ago, designed to be used for wheel-carriages, is now the possession of the proprietor of this publication. Patents have also been obtained for similar inventions. It is hardly necessary to observe how little novelty there is in the method of fastening one body within another, by casting melted metal between them. The patentee's method of heating water and of generating steam, does not require our remarks.

What similiarity the patentee can find in his barrel washing machine, and Beetham's engine, we cannot conceive: the only part of Beetham's machine that revolved was a fly wheel; but the motion of the compresser was entirely repercussive, and the fly only served to render this motion equable.

Mr. James Wood's *Patent for a Machine for Churning Milk, which may also be applied to Work Pumps. Dated May,* 1807. —*Repertory of Arts,* No. 62, New Series.

The object of Mr. Wood's invention is to facilitate the raising of the churn-dash, which is thus effected: the top of the handle of the churn-dash is attached by a pivot to the middle of a long horizontal bar, which is fastened at one end to an upright frame by a hinge; this bar is guided between perpendicular posts, so as to move only in a vertical position, and at its farther extremity is a cross handle, by which it may be forced downwards. Between the posts last mentioned another shorter bar is placed, which also has a vertical motion, and its axis passes through the post; this bar lies beneath the long bar, and to its interior extremity a weight is attached, which causes its outer end to press upwards against the long bar, and by this action raises the churn-dash. To facilitate its motion against the long bar, it is furnished with friction wheels at the post where it comes in contact with it; a spring is fixed in the frame work above the long bar, to break the force with which it is driven upwards against it by the short bar, and to prevent the noise which this would occasion. It appears from the disposition of the handle by which the long bar is to be moved, as represented by the engraving of it, that it is to be placed above the head of the operator.

Observations.—In the operation of churning, in which the resistance to the motion of the dash upwards is as great as that downwards, this apparatus will be of some assistance, as the muscles by which the arms are elevated, are considerably weaker than those by which they are depressed, and it assists the motion upwards by the counterpoise on the short bar: but in pumping it would be of little use, because most of the force used in this operation is required to depress the pump handle, but in raising it little is necessary; and the weight of the rod also assists to raise it by its action on the opposite side.

Though it may be convenient to have the long bar of the churning apparatus placed over head, yet the handle by which it is moved should be always fixed so low, that the hands in working it would never require to be raised higher than the head, as this is ever found by experience to be very fatiguing. The machinery might be made much more simple by extending the long bar beyond the joint, fixing the counterpoise to this part, and leaving out the short bar and its friction wheels altogether. Though this apparatus would certainly be of the utility before explained, yet in this respect it is equalled, if not excelled, by the contrivance in general use for moving the churn-dash, in which a vertical handle, moved

to and fro, raises and depresses an arm at right angles to it, that turns on a pivot attached to the ceiling of the dairy. And the latter contrivance may easily be rendered superior to the former, by fixing an horizontal handle to the bottom of the vertical handle, by which it might be worked by an action similar to that used in rowing, generally acknowledged to be that in which the force of man can be used to the greatest advantage. This is far from being the case with the action of pumping introduced in Mr. Wood's machine.

Mr. John Prosser's *Patent for Improvements on Smoke-Jacks. Dated Oct.* 1806.—*Rep. of Arts*, No. 63, New Series.

The first of these improvements consists in making the case of the smoke-jack to extend the whole length from the centre of the chimney to the outside of the chimney-breast, inclosing the spindle, and terminating at the chain-wheel.

The second improvement consists in raising the spindle and chain-wheel in a slanting direction upwards from the centre of the worm; by which oil put into the case at the chain-wheel will flow down to the worm, and rise above its upper carriage. The third improvement consists in making the chain-wheel of metal, and placing in its grooves tags and holes, to prevent the chain from slipping.

The specification describes a smoke-jack arranged somewhat differently from the usual mode; the communication from the worm to the chain-wheel being made in it by a succession of toothed wheels, placed vertically, instead of a spindle and single wheel; the whole inclosed in a case formed as above described. The principal advantage of this construction, mentioned by the patentee, is that it will less obstruct the passage of the chimney than the common smoke-jack, as it will take up much less space horizontally, not requiring to have its case broader than two inches.

Six figures are given in the specification of these improved smoke-jacks and their parts.

Observations.—Count Rumford having some years ago proved in the clearest manner, in his publications, that *smoke-jacks caused a great waste of fuel*, it is rather extraordinary that they still continue sufficiently in use to cause a demand for the very expensive forms in which they are now constructed, especially when so little labour is required in winding up the jacks which go by weights, and which are free from this objection; and when the small moveable spring-jacks are to be had at so reasonable a price, which require so much less trouble to wind up than the others, that the most indolent servant would be ashamed for a moment to think of the attendance they require as a matter of inconvenience.

When smoke-jacks are used, it will however be of advantage to have them formed so that the oil may be conveyed to them from without; but it does not appear that Mr. Prosser's plan is better for this purpose than those already in use, and certainly would require a large quantity of oil in the first instance, and a considerable supply afterwards, as long as it was used.

The patentee's mode of making smoke-jacks with a succession of wheels, is much more complicated, and must be more expensive than that in common use. It is certainly a desirable point to make the jack take up as little room as possible in the chimney, but it is very obvious that this might be done without adding so much to its complication.

Mr. Charles Random De Berenger's *Patent for Manufacturing Hog's Hair, so as to be used for stuffing Cushions, Mattresses, &c. Dated July,* 1806.—*Rep. of Arts,* No. 63, N. S.

After the hogs have been killed, their hair is to be scraped off in the usual manner: it is then to be washed clean, and to be thrown into lime-water, where it is to remain from one to two days, which destroys any fleshy substance remaining with the hair, and prevents putrefaction.

The hair, when taken from the lime-water, is to be washed clean in pure water, to be twisted into a cord about the thickness of a goose-quill, and then to be rammed tightly into tubes, about thirty inches long, and three quarters of an inch in diameter; which tubes are to be corked up at both ends, and to be boiled in water for two hours.

The hair taken out of the tubes when cool, is to be picked asunder, and will then be quite curly. Some of it is then to be placed loosely in earthen pans, in the bottoms of which fine dry sand has been previously put; over the hair more dry sand is to be sifted, and over that another layer of hair; and so on till the pans are filled with alternate layers of hair and sand; the pans are then to have brown paper tied over them, and to be put into an oven, where they are to remain for three or four hours, in a heat almost sufficient to burn the paper. When the sand is quite cold, the hair is to be separated from it by a sieve, which will be found to have obtained a good curl, and a fine elastic power. The hair should be twisted by a wheel, or other means, into short cords, and must be damped before it is twisted.

Observations.—It would probably be advantageous to cut hair from live hogs for the above purpose, as a greater quantity could then be procured.

Cushions, sofas, &c. are stuffed in Sweden with certain species of Lichens, and are found to be soft, elastic, and durable.

It would certainly be worth while to raise these Lichens here, as hair for this purpose has now risen to an extravagant price. The species of Lichens used in Sweden are the *Lichen chalybeiformis*, the *Lichen barbatus*, and the *Lichen plicatus*. The account of their application to this use may be found in the Transactions of the Royal Academy of Stockholm, in a paper written by Dr. Westring.

Mr. ANTHONY FRANCIS BERTE'S *Patent for a Machine for casting Types and other Articles used in Printing. Dated April,* 1806. —*Repertory of Arts,* No. 63, New Series.

IN Mr. Berte's method of casting, artificial pressure is used, to force the fluid metal more exactly into the minute cavities of the mould. This pressure is effected either by the weight of a column of the fused metal, or of water, or any other fluid; which last is made to act on the surface of the metal, by compressing a body of air against it.

To cause the pressure by the statical power of the melted metal, a vessel is prepared for fusing it, of such a figure, that the quantity of fused metal contained in it shall have its surface sufficiently high above the aperture by which it is admitted to the mould. This aperture is so contrived, that the fluid metal shall spout upwards from it into the mould; it is covered with a sliding valve, passing over a smooth flat horizontal surface; the face of the mould is also made flat and smooth, which, when it is used, is laid close to the flat plate on which the valve moves; and being pushed against the valve, forces it back, till the aperture of the fusing vessel comes in contact with that of the mould, and the fluid metal spouts upwards into it. When the mould is withdrawn the sliding valve is closed again directly by a spring, or weight, contrived so as to give it the proper motion for this purpose.

To facilitate the above operation, guides and stops are placed to direct the application of the mould.

The method of causing the statical pressure of water to act on the surface of the fused metal, by compressing air against it, is not described, but may be easily conceived.

Mr. ANTHONY FRANCIS BERTE'S *Patent for Improvements in casting Types and other Articles of Metal, communicated to him by a Foreigner residing Abroad. Dated April,* 1807.—*Repertory of Arts,* No. 64, New Series.

THE specification of this patent is a repetition of that last recited, with the addition of a method of causing the pressure re-

quired on the surface of the fused metal, by a piston fitted to a tube, that communicates with the fusing vessel, which in this case is made close on all sides, except at the aperture to which the mould is to be applied; when the piston is forced down, it compresses the metal, and makes it spout with force into the mould, on sliding back the valve.

It is also mentioned that the moulds are to be made of four adjustable pieces, instead of two, to produce a greater variety of adjustments: that they are to be formed without those parts that produce notches in the types; and that the types are to be struck out of them by a punch, or other proper tool, without opening them.

Mr. Richard Wilcox's *Patent for Improvements in (Rotary) Steam Engines. Dated May,* 1806.—*Repertory of Arts,* No. 63, New Series.

The specification of this patent relates entirely to the construction of a rotary steam engine, formed almost in every respect on the same plan as that for which Mr. Flint obtained a patent in November, 1805, which is described in our second volume, p. 521.

Mr. Wilcox's rotary steam engine consists of an outer fixed cylinder, and an inner revolving one, each furnished with pieces, called pallets or cocks, so contrived, that in passing each other, they are moved in such a manner as to recede from each other's way; but in all other parts of the circle in which they are placed, they project so as to traverse the space between the two cylinders, and form steam-tight partitions, one of which being fixed, and the other moveable, the steam pressing between both, forces the moveable one round, and with it the moveable cylinder, whose axis gives motion to the machinery, to work which the steam engine is erected. At one side of the stationary pallet is placed a valve, which by a pipe communicates with the boiler, and at its other side a second valve is fixed, which leads to the condenser; both which valves are worked by means similar to those in common use.

The ends of the cylinders are made steam-tight by rings, which press the packing against them, by means of screws: and the edges of the pallets are made steam-tight by an hempen cloth, stuffed, wadded, or folded together.

The part of the surface of the pallet which comes in contact with the revolving cylinder, has a longitudinal groove or rabbit cut down it, into which a piece of metal is fitted, that is pressed against the cylinder by screws, springs, or elastic packing, so as to come in close contact with the revolving cylinder; as this piece

is worn, it is packed closer to the cylinder, and when it is entirely worn out, another piece of the same sort is put into its place.

To make the packing work well, and last long, a supply of oil, or liquid grease, is communicated to it by a hole drilled longitudinally through the spindle of the pallet, from which another hole is formed horizontally, that proceeds to the parts in immediate contact with the cylinder; a funnel is placed outside, with a pipe passing from it into the hole made in the spindle, with a regulating cock annexed to it, between the spindle and the funnel, by which the oil can be let down to lubricate the working parts, without its being necessary to stop the engine.

To increase the power of the engine, Mr. Wilcox mentions that two or more sets of pallets may be added to it, by which the steam, or impelling fluid, will be made to act in two or more places at the same time.

A fall of water may be used to turn this engine, as well as the pressure of steam. The specification states, that all elastic or dense fluids are applicable to it. But it is not very probable that any fluid except water, or vapour will be used with it.

This engine may also be used to pump up water, or as a blowing engine for furnaces, when set in motion by an external force, and having the tubes to and from it and the valves properly disposed.

Twelve figures are given in the specification, of various modifications of the engine, and of its different parts. Its last clause relates to the shape of the body of the engine, which, it states, may be of a conical form, as well as cylindrical.

Observations.—The contrivance in Mr. Wilcox's engine, for moving the pallets, and for making them pass each other, is the same as in Mr. Flint's engine: the method of packing the bottom of the revolving cylinder by a ring, is also the same.

Mr. Wilcox's engine differs from Mr. Flint's, in having a contrivance for packing the edges of the pallets, which come in contact with the revolving cylinder, and for repairing them; also in the method by which the oil is conveyed to the working parts from the outside, and in having two or more sets of pallets.

The method of packing the edges of the pallets renders Mr. Wilcox's engine much more perfect than Mr. Flint's; in our observations on which we pointed out the great disadvantage under which it laboured, for want of a contrivance of this kind. The advantage of having two sets of pallets, lies more in equalizing the motion of the engine, and in preventing its being liable to stop, than in any force which can be gained by their use; on the contrary, the additional friction they must occasion, would rather retard the engine; but they have this advantage also, that the engine in which they are used, may have its power increased by enlarging the boiler, or adding another boiler to it, (to supply the

greater consumption of steam which they will occasion), without altering any other part of it.

Mr. Wilcox's engine should rather be considered as an improvement on Mr. Flint's, than an original invention. How far Mr. Wilcox can use Mr. Flint's inventions, without his permission, we will not decide; but Mr. Flint's engine is certainly much improved by the additions of Mr. Wilcox. We believe the best rotary steam engines that can be made, will ever be more complicated, possess more friction, and consequently more liable to derangement, than those of the common form; so that the latter are always likely to have the preference, and the former have little or no chance of coming into general use.

In our first volume, page 223, and in our second volume, pages 381 and 521, different rotary steam engines are described, and their merits and defects discussed; what we have said already in our observations on those, will, we think, justify what we have now remarked. Mr. Wilcox's rotary engine, though the best we have yet examined, is still liable to the general objections.

Mr. James Peache's *Patent for a Floating Buoy on a new Construction. Dated April,* 1807.—*Rep. of Arts,* No. 64. N. S.

Mr. Peache's buoy differs from those in common use principally in the contrivances to make it staunch, that there may be scarcely a possibility of its leaking. The staves of which they are composed, are all rabbetted together at their edges, and between the joints have a thin layer placed of hair, flax, or other fibrous matter, upon which a coat of a warm mixture of pitch and tar is laid, immediately after which the staves are put together, and secured by hoops, bolts, pins, or other fastenings. The heads of the buoys are also rabbetted to the sides, as well as in their component pieces, and have all the joints secured with hair and pitch, in same manner as before-mentioned; in some cases two or more heads are placed within the external heads for greater security.

A trunk, or tube, constructed so as to be perfectly staunch in its joints by the same means already described, is fixed in the middle of the buoy; through which the mooring chains, cables, or ropes, are made to pass, in the same manner as ropes are passed through the small buoys made of single pieces of wood. Two or more such trunks are to be used in certain cases.

These buoys may be made of any convenient figure, but in general the cylindrical, prismatical, or conical is preferred.

Observations.—Much care seems to have been taken to contrive these buoys, so as to last long in a perfect state, and they appear to us well worthy of a decided preference over those in common use.

Mr. Richard Lorentz' *Patent for Inventions of Instruments which produce instantaneous Light and Fire, communicated to him by Foreigners residing Abroad. Dated February,* 1807.—*Repertory of Arts,* No. 64. New Series.

Two contrivances for the purposes recited in the title are described in the specification of this patent: In the first, the electrical instrument, called an electrophore, (with which a spark can be produced by merely separating two properly prepared disks), is placed adjoining to a vessel containing zinc and diluted vitriolic acid for disengaging hydrogen gas; which, as it escapes, forces water contained in a second vessel upwards through a pipe, into a third that is above it, the weight of which re-acts on the disengaged hydrogen on turning a cock, so as to force out a stream of it with considerable velocity through a small aperture prepared for delivering it, near which two small metallic balls, connected with the electrophore, are so placed, that on producing a spark, it passes from one to the other through the stream of hydrogen gas; which being directed to the wick of a candle placed near it, as soon as it is inflamed by the electrical spark, lights the candle.

The other instrument consists of an air syringe, about a foot long, which forces common air with great velocity, and in an highly condensed state, through a small aperture, against some prepared fungus, or agaric, commonly called German tinder. The whole is included in an hollow staff, and is made to operate by pressing the rod of the discharging syringe strongly against the ground, so as to drive the air suddenly against the tinder.

Observations.—Both these contrivances have been long since described in English philosophic publications, but the latter more recently in Mr. Nicholson's Philosophical Journal.

The complication of the first instrument must ever render it an object of curiosity, more than of use, and at best it can only be considered as a philosophical toy.

The second instrument, if well executed, might be convenient; and is sufficiently simple to admit of its application for common purposes, and of being sold at a moderate price.

Many might prefer it to a common tinder-box for its novelty, and to avoid the disagreeable smell of the lighted matches: though with a little attention in having flints, and good dry tinder, or agaric, this old-fashioned instrument is as convenient for producing instantaneous fire and light as need be desired.

Mr. Ralph Wedgwood's *Patent for an Apparatus for producing Duplicates of Writings. Dated October,* 1806.—*Repertory of Arts,* No. 64, New Series.

In writing by this mode, two kinds of paper are used, viz. thin oiled paper, and paper upon which is spread any colouring substance, finely ground with oil, and which then has been placed for some time between blotting paper. In lieu of oil, other vehicles may be used, and some colouring substances may even be used without any vehicle, provided they admit the colouring matter being transferred to the oiled paper and writing paper.

To write a single copy, the coloured paper is placed between the oiled paper and a plate of metal, or other smooth substance; and the writing is performed by a style made of agate, or any other hard substance, ground to a smooth round point. As the oiled paper is transparent, the writing appears through it, as if written upon the paper.

To write two copies, a leaf of writing paper is added to the former apparatus, and placed between the coloured paper and the under plate, by which means the colour on the paper is transferred not only to the under side of the transparent oiled paper, but also to the upper surface of the writing paper.

The plate of metal may be omitted, but then the writing is not so distinct.

To make a further increase of writings from an original, he uses, instead of the common alphabet, the position of a point, or other mark in a square, or other figure. The apparatus for this purpose is a type tablet, being a collection of sockets, in which the types are made to slide rather stiff, by having their sides rubbed with wax, or some other substance. To determine the proper type to press down, the upper surface of the tablet is marked with squares, or other figures, corresponding to others marked on the paper employed to receive the copies. A plate of metal is adjusted to the under surface of the type tablet, to regulate how far the types are to be pushed.

In order to fix the types, previous to employing the tablet in printing, melted lead, or some other substance, is to be run into the sockets of those types that have been depressed. The tablet may then be used, to print in a common press, observing that the squares or other figures marked on the paper agree with those on the tablet. Or, leaves of thin paper marked with squares, &c. and of coloured paper may be laid alternately, and the stereotyped tablet pressed on them. The lead being then melted out of the sockets, the types may be pressed level by a wooden or metal tablet, and thus left ready for a new operation.

To write with these new characters, as many leaves of oiled paper, marked with squares, &c. as are necessary, are to be placed alternately with coloured paper, and the type tablet placed

over the whole. By pressing down the required types with a metal point, the necessary copies are produced.

Observations.—The former part of this patent is only an extension of the old method of *tracing*, or *calking*, which has been used for ages in producing fair copies of rough sketches, or in copying out-lines upon the plate preparatory to engraving with aquafortis; so that its only novelty is the simultaneous production of the original, and its copy by one and the same stroke.

The preparation of the coloured paper, called by Mr. W. "carbonated paper," is not only obscurely delivered, but from the affectation of employing technical terms, he has exposed his ignorance of chemistry, and rendered his process impracticable, if literally followed. He orders the colour for this paper to be prepared of "carbone, finely levigated in any kind of oil." Now it is well known that carbone, is a mere hypothetic principle, substituted by Lavoisier for the phlogiston of Stahl, and has no separate existence in nature. At the time when this patent was taken out, the diamond was supposed to contain this principle in the purest, and by some to be in fact identical with it; but it requires no arguments to shew the unfitness of the diamond for the proposed colouration. It is probable that Mr. W. means charcoal, lamp black, bone black, Francfort black, or some other carbonaceous residuum.

The use of soft wax to connect the papers together at the corners, and of a hand-board, such as is employed by engravers in this operation, seem necessary to prevent the papers from being smeared with the colouring matter by the pressure of the fingers, which, without these helps, would be unavoidable.

The trouble of acquiring a new alphabet, by the situation of the same mark in different parts of a square, or other figure, will always render the latter part of his patent of little or no use.

CORRESPONDENCE.

We are obliged to EMERITUS, *for the good opinion he expresses of our work, as well as for his suggestions and remarks, relative to Francini's Pump and the Hydraulic Ram, which were noticed in vol.* i. *p.* 211 *and* 216; *and in vol.* ii. *p.* 157. *These remarks shall be attended to, whenever subjects of a similar nature may occur; but we trust* EMERITUS *will perceive that it would be incompatible with the plan and limits of our work to insert letters that might lead to a lengthened correspondence, or by any means to lay the foundation for controversy.*

No. XI. will be published Feb. 1, 1808.

RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL AND AGRICULTURAL

DISCOVERIES.

No. XI.] *October, November, December.* [1807.

AGRICULTURE.

General Observations on the Practice and Principles of Irrigation. By the Rev. Wm. Singers, *of Kirkpatrick-juxta, Dumfries-shire.—Transactions of the Highland Society,* Vol. 3.

In practising irrigation with success, the reverend author holds it necessary to ascertain the Quality of the Water, to be employed for the purpose. This he observes may be learned by the experiment of letting a small portion of land be floated with it for a month about the latter end of harvest, and afterwards for a week or two about the latter end of spring: by these means its effects upon the the grass may be easily ascertained, and the warmth of the water discovered, by noticing its power of resisting early frost; a point considered by the writer of great importance in irrigation; the appearance of water being by no means sufficient to determine its qualities; thick muddy rivers, however, are always efficacious, but clear streams differ essentially, and their qualities are most safely and most certainly ascertained by observing the effect of the water, and the period of its freezing, as warm rivulets, containing great quantities of spring water, and resisting early frosts, may be expected to encourage an early pasturage, and to produce tolerable crops of hay.

The choice of Lands for watering is stated to merit consideration, for though this practice may be safely resorted to on farms which have no tendency to produce the rot, yet where there is any risk from this distemper, the farmer cannot be too cautious

how he suffer water to remain stagnant, and will certainly allow no summer watering: the level and slope of the ground must also be attended to, and the water laid on with due consideration of these circumstances. The *quality* of the soil is represented as of little importance where the water deposits a fertilizing sediment; but where this does not obtain, loam is asserted to repay the Irrigator with the best crops; mossy soils to answer very well; clay not to produce so abundantly; and gravel to be, in comparison, generally poor and unproductive.

The WEARS OR DAMS should be suited to the nature of the stream; a few sods with stones laid upon them being sufficient to divert the course of small rivulets, while for currents of considerable extent, wooden beams may be required to be thrown across the stream, and planked, and afterwards made firm with stones: or wears may be made with rows of stakes interlaced with fir branches or hedge wood, and the intervals filled with stones and turf.

The CONDUCTOR OR MAIN CARRIER, by which the water is conveyed into the meadow, is usually an open ditch or trench. A gentle equable declivity should, if possible, be preserved, which causes the water to move softly, and prevents it from wearing down the sides of the ditch: the conducting drain should rather take the water from the bottom than the top of the rivulet, because it is more likely to be impregnated with earth and other fertilizing substances, when drawn from the bottom.

When the stream is powerful, and the conductor large, the SLUICE OR HATCH should be firmly constructed of oak, well fixed in masonry, and rendered water-tight by ramming or puddling; but when a small rivulet of water is employed, no sluice is necessary, as a few sods will turn it on and off at pleasure.

These preliminary operations being completed, the attention of the Irrigator is directed to the FORMING OF A FLAT MEADOW, or in other words, so levelling the soil, and disposing the drains, as that the surface may be uniformly covered. This requires some skill, and much attention where the meadow is not uniformly flat, but by the assistance of *catch-work*, and cross-drains may be accomplished without considerable difficulty.

The principle of the mode of watering called CATCH-WORK, consists in floating as much of the surface as can be done in one level, and then by the intervention of intermediate dams, transferring the water to another level, and so on till the whole is floated. This mode requires a smaller quantity of water, and is more particularly adapted to lands on a declivity. The easiest mode of application is pointed out to be cutting the feeders and drains in a direction across the slope of the surface, with a sufficient fall for the water to move slowly and gently, without either stagnating or acquiring such rapidity as to endanger the works.

As in Irrigation the rough parts of a meadow must be frequently pared off, and some trivial work done in levelling, which leaves a

part of the sweard bare, the attention is next directed to THE SEEDS MOST PROPER TO BE SOWN in such places. And though experience and attention are admitted to be the surest guides in this important point; yet as that experience may not have been obtained by all who adopt the practice, the creeping meadow grass, the poa, the dog's tail, the scented vernel grass, and the white and the creeping bent, are recommended to be sown in preference to other kinds, all these grasses being well adapted to furnish a crop of hay, and to yield a very abundant pasturage.

In regard to the PROPER SEASONS AND MODES OF WATERING, the author expresses himself to be decidedly of opinion that the water should be set on as soon as possible in the month of October. The effects of this he considers very important in strengthening the roots and stalks of the plants, and preparing them for shooting strong and vigorously in the succeeding spring: whereas it frequently happens that by delaying the watering process too long, early frost supervene, and very much impede or prevent that operation. As to the mode, separate divisions of the meadow may be watered in succession, or the whole be floated at once, as circumstances will admit; but whenever scum appears on the grass, the water is directed to be immediately removed, though it is not safe to remove the water in severe frosts, as it operates so far to protect the grass, as that if it were afterwards exposed to wet and frost, it might be greatly injured. A repetition of the irrigation is recommended in the spring, when the fine rich verdure that appears, and the soft unctious tread of the soil are indications of advantage being received; after which an excellent crop of hay may be reasonably expected.

The importance of MAKING AND STACKING OF MEADOW HAY in summer is explicitly admitted, but it is recommended to the farmer not to cut the hay of water meadows too soon; for in this case the natural softness of it is increased, it loses a greater proportion of weight and substance in making, and though more palatable, is less nourishing to cattle: it should be thoroughly made, and got together in not very large quantities, as it is extremely liable to heat.

The PURPOSE TO WHICH THIS HAY IS MOST ADAPTED, the writer has no hesitation in affirming to be the feeding of black cattle, which thrive upon it extremely; and he thinks it better calculated for horses, than for sheep, if moderately allowed. He has never seen milking cows or young cattle prosper better than when put on this hay in the spring, after having been fed on straw and turnips during the winter.

With respect to THE ACCESS TO THESE MEADOWS FOR CARTS AND CATTLE, it may be supposed, he observes, that a common cart would not be capable of being drawn over a meadow with such a number of drains, and that cattle could not be introduced without danger; he admits the advantage of employing steady horses, and carts with wheels of a large diameter and broad fellies, and asserts

that horses soon acquire the habit of stepping across the drains, without any uncommon exertion.

It is remarked in CONCLUSION, "that water is a good servant, but a bad master, and must therefore be managed in such a way, as to be always under command." When land is floated, Mr. Singers advises that it should be *fully* done, without attempting too much at a time, and when laid dry, should be perfectly freed from water, for by this alternate succession, the plants not only rise in abundance, but also prosper to a high degree; the periods of watering, he states to be from six to nine weeks in the year, including the different periods; but the due proportion varies according to circumstances in the soil, water and climate. It is evident to him that water raises the temperature during winter, so long as it is capable of resisting the frost, and in summer corrects that extreme drought which tends to wither the grass: water therefore as a mere element is useful in nourishing and protecting the grass; but when mud is diffused, or calcareous matters dissolved in it, and the grass has the power of straining these substances out of the water, their effect may readily be conceived. Watering also seems to him to promote the putrefaction of dead substances in the soil, and in this way to operate as a powerful manure.

Observations.—This very sensible essay, on so important a subject in agriculture as irrigation, deserves to be classed with the ingenious tract of Mr. Wright, on the art of floating land. The assertions here laid down, are borne out by philosophical reasoning, and the instructions given are too plain to be mistaken, even by the most careless and indifferent. The division of the subject into distinct sections (which is also preserved in the paragraphs of this article) tends to render the arrangement perspicuous, and prevents any part of the operation from being passed over unnoticed. Though the publication from which it is selected has a local tendency, yet this article is general in its use, as it is general in its application; and the Reverend William Singers will be known as an intelligent agriculturist, far beyond the limits of his native country.

Report of a Survey of watered Meadows, situated on or near the Rivers Esk, Ewes, Tiviot, Etterick, and Yarrow, made in 1804 *and* 1805 *—By the Rev.* WILLIAM SINGERS, *of Kirkpatrick.—Transactions of the Highland Society, Vol.* 3.

THE Highland Society being desirous of obtaining a report on the improvement made by Irrigation, in the districts named in the title, requested the author of the preceding essay to undertake the task. He acceded to their request, and inspected the meadows first, towards the end of October, again in April, and the third

time in the August following. This paper merely contains a descriptive account of every meadow which underwent his inspection, with the name of the occupier, the quantity of the land, the appearance of the grass, the mode in which the water was laid on, and those local particulars which the duty of his appointment required, but which neither admit of abridgement, nor afford any except local information. Some sensible remarks are, however, occasionally subjoined, which will make ample recompence for the trouble of reading the report.

Account of the Improvement of a Tract of barren Ground covered with Heath, in an elevated Situation, in the County of Peebles.—By Mr. James Allan.—*Trans. of the Highland Society, Vol. 3.*

The method pursued in this improvement was ploughing the ground at intervals of leisure, during the summer, and suffering it to remain in that condition till after the harvest, when it was manured with lime in the proportion of twenty bolls to the Scotch acre; the boll of lime containing sixty Winchester bushels. From the situation of the ground, the medium elevation of it from the water being four hundred and twenty-two feet, it was ploughed with a single furrow in an oblique direction: the lime cost 1s. 2d. per boll at the lime works 16 miles distant; it was, however, preferred to dung, as a manure, from the greater ease with which, on account of its small weight, it could be carried to so great a height. The lime was laid upon the ground during the winter, and in spring the land was ploughed a second time, in a contrary direction to the former ploughing, and then sown with oats: a second crop of oats was raised upon it the following year; the next crop was pease, and it was then sown rough barley, or bigg, and grass seeds to convert it into pasture. In the oat crop Mr. Allan sowed one boll per acre, and reaped seven, and in the pease crop he sowed three firlots and two pecks on the acre, and reaped on an average eight bolls. The expense of the process was about four pounds the Scotch acre, and he estimates the average value of the land, in its present state of improvement, at between fifteen and twenty shillings per acre. His complete success has induced him to convert several adjoining pieces of land into pasture, by a similar process.

Observations.—This communication affords a valuable example of the effects of industry directed by sound judgment. The improvement of so elevated a spot would have been thought too arduous an attempt by most agriculturists, therefore the more credit is due to the man who attempted it, and he fully merits all the success which has attended upon his endeavours. There are many parts of uncultivated districts which would return an ample remu-

neration to the adventurous cultivator, who is bold enough to undertake to reclaim them; and the example and success of Mr. ALLAN will operate as a stimulus to future improvers of the soil.

An Essay on Peat, its Properties and Uses.—*By* JOHN NASMITH, Esq.—*Transactions of the Highland Society, Vol. 3.*

AFTER an introductory observation, the essay commences with inquiring into the composition of Peat, its nature and qualities. Mr. Nasmith considers its origin to be nothing else than an accumulation of those vegetables formed by nature to thrive in the cold and damp, which water stagnating on the surface occasions; and one generation of these growing over another in the course of time in a neglected country. The trees, which are frequently found under peat beds, give strength to this opinion, and indeed may have been the cause of the peat itself by impeding the currents of water, and causing it to stagnate. In stagnant pools rank aquatic herbage soon springs up, and this is given as the origin of peat beds. This substance is described as of a dull orange colour when first brought to the light, but changing to brown or black after exposure to the atmosphere; the lower strata are the more solid, and the upper of a fibrous texture.

The different vegetables which are commonly found in peat beds are then accurately described in the scientific language of Linnèe; and the theories of other writers, whether they confirm or are opposed to the sentiments of the author, are impartially detailed.

The properties of peat, which have chiefly claimed the attention of naturalists, are stated to be its inflammability, its power of resisting putrefaction, and its incapacity of producing vegetables capable of being cultivated upon it in its natural state. Its inflammability it possesses in common with other bodies of the same origin; it contains very little earth, repeated experiments by this writer having given not more than five and a half drops of ashes in a pound averdupois, and similar results were obtained by him from solving it in different fluids. Decomposition afforded very various results, but in all cases lime, soda, and magnesia were found, and in distillation it was discovered to yield the same products as other vegetables. The power which peat possesses of resisting corruption accounts for the prevalence of this substance in cold countries, where one generation of vegetables grows over the top of another, and all remain with little diminution of their bulk: this property of resisting putrefaction is said to have caused the juice of peat beds to have been formerly applied to the tanning of leather. The natural incapacity of peat to produce esculent vegetables results, in the opinion of the writer, from the properties already mentioned; for, being destitute of earth, and composed of a congeries of vegetable fibres, it holds water like a sponge, in a sluggish state, rather calculated to suffocate than to nourish land

vegetables: but after the natural confirmation of this substance has been destroyed, and the original particles separated, it will produce cultivated vegetables, without being mixed with earth, though much less vigorously.

The value of peat is then noticed as a manure, and the opinions of Lord Dundonald and Lord Meadowbank are quoted, and the difference pointed out, the former recommending it to be mixed with lime, and the latter with wet dung. Notwithstanding this difference of opinion between these respectable authorities, the writer considers them both to be proper, as lime is the best decomposer of vegetable substances, and wet dung a powerful promoter of putrefaction. He thinks, therefore, that the most advantageous method would be to mix it first with lime to separate the parts, and when this process is completed, to mix the whole with wet dung to bring about putrefaction.

Having thus attempted a description of the origin, nature, and properties of peat, comprehending all the knowledge acquired in a long course of observation and attention to the subject, the author conceives that from these data some judgment may be formed concerning the uses to which it is applicable; and, without attempting to lay down positive rules for reclaiming land of this description, he has subjoined a few hints which have occurred on the subject.

Whether peat land is intended to be prepared for the production of crops annually cultivated, or be converted into grass and pasture, he conceives the first necessary process to be draining and levelling the field, as the stagnant water retained in the interstices of peat, in its natural state, have been stated to be one great cause of its incapacity of producing land vegetables. Various modes of draining away the water are suggested, which it is unnecessary to recapitulate, as being differently applicable to different situations, and sufficiently obvious to every intelligent husbandman. In his attempts to prepare this substance for the production of cultivated vegetables, the writer proceeded with a variety of experiments, from which he deduced the four following corollaries;—"1. That though peat be incorruptible in its native state, yet when its original texture is deranged by smothered combustion, or by the intervention of foreign substances among its interstices, the carbon it contains becomes soluble in water, and furnishes abundant food to growing plants:—2. That the primitive earths which are ingredients in other soils, are also necessary in peat, not only for the purpose of subduing its resistance to solution, but for affording the solidity requisite to permanent fertility: —3. That lime, differing widely in its qualities from the other earths occurring on the surface, is not capable of rendering pure peat soluble in water, unless it be accompanied with these earths; but combined with them increases the fertility of peat, by facilitating its decomposition, and forms a soil favourable to the grasses: 4. That cohesive earth, which has suffered torrefaction,

such as brick-dust, is a most powerful solution of peat." By an attention to these circumstances, he conceives it easy to reclaim peat, and render it fit for the production of cultivated vegetables; and is of opinion that the intelligent husbandman will succeed better by using his judgment, and adapting his management to particular circumstances, than by being fettered with particular rules.

Even when peat is to be converted into grass and pasture, Mr. Nasmith recommends that it should first be cropped, and then made smooth and level, which he thinks may be effected by three crops; the land to be afterwards well compressed and smoothed by repeated rolling: he apprehends it would also be of great importance to provide the seeds of such native grasses, as are adapted to the soil, which might easily be procured by moderate diligence.

And when peat is intended to be applied to other lands as manure, a variety of experiments have convinced him that no better plan can be adopted than that before mentioned. In conclusion he expresses his conviction that the cultivator of peat lands would reap much private benefit, at the same time that he benefited his country.

Observations.—This essay on the improvement of peat lands evinces at once the general information, and the accurate observation of the author. It may be considered as an epitome of all the theoretical knowledge on the subject, and points out the plainest methods of making it practically useful. The practical farmer will certainly find more learned names in this composition than he will readily comprehend, and it might have been more favourably received by that useful class of men if learned terms had been less frequently introduced. The various accounts of improvements of peat and moss, which have been published in the Communications to the Board of Agriculture, the Transactions of the Society of Arts, and other publications, may be considered as commentaries, to which this essay may with much propriety be considered as the basis.

On the Diseases of Wheat.—By Mr. Robert Harrup, *of Chobham.—Phil. Journ.* No. 79.

This gentleman had been led to conjecture, from some observations that animalcula might probably be the cause of *smut* in wheat, but as it still remained doubtful whether these minute creatures might not be the effect rather than the cause of the disease, he resolved to attempt an analysis of the smut itself. His inquiry, however, not being completed, he is only warranted in announcing at present that *one* of the component parts of smut is the sole cause of that destructive malady, and that wherever it exists, whether in the *seed* or in the *soil*, the crop will be tainted.

He therefore earnestly recommends all practical agriculturists to prepare their seed wheat in the following manner.—A sufficient quantity of lime-water to be prepared, by mixing boiling water and quick-lime together, in the proportion of a pound of lime to three gallons of water, pouring off the liquor after having stood an hour or two in a covered vessel, which, if not immediately used, should be kept closely covered; the wheat to be put gradually into this liquor, at the same time carefully taking off the light grains which float on the surface: after standing, covered with the water to the depth of five or six inches, and the vessel closely shut during twelve or fifteen hours, stirring it twice or thrice in that time, the liquor to be drawn off, and the wheat put on a floor. The following mixture is then to be poured regularly over it, viz. five pounds of lime stirred in three gallons of boiling water, till the lime be reduced to a powder, which will happen in a minute or two; it is then to be intimately mixed with the wheat, which, after lying covered with cloths for some hours may be dried with lime in powder, and immediately sown. He considers this quantity sufficient for five bushels of grain, and thinks that more ought not to be prepared together. He expresses himself of opinion, that this effect is not confined solely to lime, but may be obtained by using either of the fixed alkalis, and is engaged in a series of experiments to ascertain the result.

With respect to *blighted wheat*, he observes, that in Adams's essays on the microscope, by Kammacher, there is given a description of animalcular eels, discovered in wheat affected by this disease: the grains are said to be blackish, but to contain a white substance, which, immersed in water, separates into numerous filaments, each of which is a living creature. This experiment was first made by Needham; and M. Roffredi (a French naturalist) sowed some of the grains, which vegetated, but the ear was wholly filled with these minute animals, which increased in size in proportion to the growth of the plant, so that they were at last visible to the naked eye. This is the disease which is called *ear-cockle* in some parts of the country, and in others is denominated *burnt wheat*, from the appearance of the grains. The cause seems to Mr. Harrup to be either in the seed or in the soil, or perhaps in both, but by no means to be influenced by the weather. The ears have much the appearance of smut on a superficial view, but are found very different on examination: before they are ripe they are of a dark olive green colour, not exactly the shape of sound grains, and contain a soft white matter, round which the coat appears scorched when the grains are ripe. If soaked in water and opened, the animalculæ have perceptible animation, which is suspended when the grain again becomes dry. They are very long-lived and affected much by a strong light, as the rays of the sun, or the light of a candle, and are instantly destroyed by adding a few drops of lime-water to the water containing them; and if the grains are steeped in lime-water for twelve hours, the animal-

culæ are incapable of being revived by any means whatever. For this reason the same preparation as for the smut, is recommended as a certain preventive of ear-cockle.

From a few observations which Mr. Harrup has made upon the *blight*, he thinks it is occasioned by parasitic fungi of different species, none of which are particularly injurious, except the dark-coloured, which destroyed so many crops in 1804. He has paid much attention to the orange-coloured, which appears early in the summer, and is of opinion, that it is a different species from the black, and not the black in an immature state. He considers these fungi to be chiefly produced by heavy rains, but has not obtained a sufficient number of facts to warrant any conjecture as to the manner in which they are produced. He fears, however, that this, like all other diseases which depend so much on the state of the atmosphere, must ever baffle human ingenuity to prevent, and he advises to cut the crop before the blight begins to make any serious progress.

Observations.—The importance of ascertaining the causes, in order to remove the effects of diseases in wheat, is too universally acknowledged to stand in need of our recommendation. The observations of this writer on the subject, appear to be dictated by strong sense and much general information, and his experiments throw considerable light on some part of the subject. We agree with him in opinion, that all alkalis are as destructive of smut and ear-cockle as lime is acknowledged to be: but we cannot avoid calling his attention, and that of others who may make the experiment to the circumstance, whether some of the alkalis may not at the same time destroy the vegetative power of the corn itself. Experience having sufficiently evinced that lime does not destroy the vegetative power of the corn, and if, as this writer asserts, it certainly destroys ear-cockle, and is believed to be the best antidote to smut, we submit that it is much safer for the practical farmer to adhere to the remedy adopted by his forefathers, than to risk not only the loss of his corn, but also of his ploughings, and labour, and crop, at the next harvest, by resorting to remedies proposed by the interested and the designing. This caution is not intended to apply to any suggestions likely to originate with Mr. Harrup: to him the Agricultural world is greatly indebted, for pointing out in this paper a more effectual mode of the application of lime, than has been hitherto extensively practised.

Method of Preserving the Cream, and a great part of the Milk, during the rearing of Calves. By Mr. Schnee.—*Rep. of Arts, Second Series. No.* 65. *from Bibl. Physico-Economique.*

The mode adopted by M. Schnèe for rearing calves, and which he thinks is preferrable to permitting them to suck the mother, is as follows. He puts on the fire nearly as much water in quantity

as the calf will drink, and when it boils, throws into it one or two handfuls of oatmeal, and suffers the whole to boil for a minute. After it becomes as cool as new milk, he mixes with it two quarts of milk which has been skimmed, stirs the whole together, and gives it to the calf, who readily drinks it, after having been learned so to do by presenting the fingers to it for a few days. M. Schnèe has long practised this method, and has uniformly found his calves as strong and as healthy as those of his neighbours, and as little subject to diseases. He seldom suffers them to suck at all, but gives them the pure milk of the mother for the first four days. His only exception to this rule is when the cow calves for the first time, having remarked that in this case the lacteal vessels open more, and the cow is milked with greater ease, if the calf be allowed to suck for a few days.

Observation.—If the method of rearing calves recommended by M. Schnèe be found on experiment to succeed as well in England as he states to do in France, the information is important in the breeding counties, where it may probably be resorted to with success, but it does not appear either reasonable or probable that this plan can be adopted where calves are fatted for the market.

A method of sowing Clover, and a new Plan for a Rotation of Crops. By M. De Vincens *of Thède, near Clermon.—Phil. Journ.* No. 79, *from Sonnini's Bibl. Physico-Economique.*

When the weather is dry at the end of winter, M. De Vincens sows his clover on land which had been sown with rye the preceding autumn; the seed is harrowed in with a common harrow, and this process, instead of injuring the rye, rather accelerates its growth. When the rye is ripe, it is cut in the usual mode, and the clover may be mown in September the same year, and cattle be afterwards fed on it till the frosts come, without inconvenience. He asserts that the second year of clover may be mown three times for hay, or four times for green fodder, and then depastured till the frosts come. The third year he mows it but twice, and when it is shot up a little after the second cutting, ploughs it in with the simple plough of the country, and by repeated ploughings and harrowings, brings the land to a proper tilth for wheat or rye. Clover he considers to be a natural manure for wheat, particularly if the clover has been dressed the preceding spring with plaster of Paris, though it will succeed very well without, though in both cases it is indispensable to weed the succeeding crop with the most diligent attention. He prefers sowing clover on rye in the spring to sowing it on oats, not only because the crop of rye is more valuable, but because he is convinced from experience that the clover is more forward: the rye being already at some height, it germinates and grows more advantageously under its shelter, particularly in dry seasons. After the first crop of corn without dung, he again sows rye, manuring

it well, and then winter peas immediately on the stubble, covering them in with a single ploughing and harrowing. This crop he has never found to fail. When the peas are carried, he dungs the ground and sows it again with rye, and the following spring, crops the ground partly with potatoes, partly with other roots, and the rest with vetches mixed with oats, to be cut as soon as the seed has formed, and employed as pasture. All these crops are previously manured; and when the ground is again cleared, he manures well, and commences his rotation anew with rye, on which he sows clover in the spring, as mentioned before, considering the manure necessary on account of the clover.

He recapitulates his course of crops, and observes that it will be seen he takes care to have a crop of corn once in two years; and as clover interrupts this course by occupying the land two years following, it is balanced by two successive crops of corn after the clover. He remarks, that, except after the clover, his land has never two successive crops of grain, unless the winter-peas be reckoned so, which do not exhaust the land; and that it is so ordered as to be cropped with corn one year, and with roots or green food the next.

An annotation is subjoined by the Editor, on constant cropping compared with occasional fallowing, in which the comparative calculation is placed in a fair and full light, and the annotator is inclined to doubt on which side the balance preponderates.

Observations.—The method of sowing clover with rye, in preference to spring corn, is certainly deserving of imitation in this country, where the young plant is more in need of shelter for its protection; but the luxuriance of growth peculiar to the more southern latitudes of France, must not be looked for in the changeable climate of Britain. The precaution of M. De Vincens not to stock his clover in frost, is equally important in all climates, for at that period in consequence of the looseness of the ground, this plant is liable to be torn up root and branch by the cattle, and the crop consequently destroyed. This frequently happens, even to farmers of considerable experience, and it has long been matter of surprize that the circumstance has not been more generally attended to. The rotation of crops recommended in this paper is ingeniously contrived, but can never be advantageously adopted in Britain while rye forms so inconsiderable a part of the food of the people.

On the Mildew. By Mr. William Jones, *of Fox-down Hill, Wellington, Somersetshire.—Com. to the Board of Agriculture, Vol.* 5.

This communication is introduced by a letter addressed to Lord Sheffield, the President of the Board, in which Mr. Jones notices the pleasure that must have been afforded to all lovers of Agri-

culture from Sir Joseph Banks having turned his attention to that important agricultural subject, the mildew in wheat—and of the interest excited by the Essay on that disease published by the right honourable Baronet. But having forgotten, from the length of time since he had read the Essay, whether Sir Joseph considered the fungus, which by the help of a microscope he had discovered on the straw, to be the *cause* of the injury, or only the *effect* of some other cause, he submits to the consideration of the Board, an hypothesis as to the *cause* of the injury, founded on some observations of his own. He also hopes for the approbation of the Board as to that part of the communication, which treats of the state or condition in which the wheat should be reaped, and the subsequent management of it when mildewed, as that will afford some remedy to lessen this great evil; and being the result of actual experience, is submitted with the greater confidence.

The reader's attention is solicited by Mr. Jones to some particulars respecting the mildew which favour his hypothesis. The first is, that he believes it is generally admitted to be produced by great dews; and, that dews have the same relation to frost, as rain to snow; he has, therefore, considered *frost* to be the primary cause, and supports his opinion by the following observations, not confined to one year or two but the experience of many; "that it is at times discovered in the leaf of the wheat plant in May, and from that time the stalk, either before or after the ear shoots out, is seldom seen to be at all affected before the latter end of July, or to be *materially injured* till a week or two in August, and then confined to the *greenest wheat* containing more sap, without extending to riper containing less, in the same field." He has remarked, and believes it to be generally admitted, that plants are liable to receive injury by frosts in proportion to the quantity of sap contained in them, or aqueous particles resting on them; and by way of illustration to those who have not given the subject a consideration, he wishes to remind them that early garden peas and beans planted in October and November have received in April and May, when their growth has been quickened and the quantity of their sap increased, a very severe check by a much slighter frost than they withstood in the winter months. And it has frequently happened in the months of April and May, that a very slight frost has totally destroyed the blossom of the apple, if it had been previously wetted by rain or mist. This happened in the spring of 1804, when the crop of apples was totally lost in the vales, though they were plentiful on the high lands. As the month of August is equally distant from the summer solstice with the month of May, it is no more extraordinary that there should be frosts in the former than in the latter, and Mr. Jones asserts that a thermometer, placed near the ground in the night in a chilling dew, would satisfy any doubts, if the degree it was reduced to was marked before sun-rise.

Mists prevailed very much in the vales the latter end of July

and beginning of August 1804; and the mildew that year reduced the promising expectation of a crop, of more than twenty bushels to less than half in the vales, and this on the best lands, though on high mountainous situations lands newly brought into cultivation produced crops of wheat of full sixteen bushels per acre without a spot of mildew to be seen it.

That mildew is sure to affect the late sown wheat, Mr. Jones observes, is too well known to stand in need of examples; and in his opinion the reason obviously is, because it is *in a green state in the beginning of August,* and more subject to the effects of frost in that month? "for who can remember," he asks, "or who has ever heard of damage by mildew, when wheat was ripe by the middle or latter end of July?" Since then the harvest is generally later than in the middle of the last century, and the wheat consequently more subject to the effects of mildew, he considered it of importance to sow late wheat lands (after turnips) with such sort of wheat as is most likely to resist these cold chilling dews, which may happen before it arrives at maturity; and upon enquiry among intelligent farmers he found a red wheat almost universally sown up the cold poor lands of the West of England, and found it bear the winter much better than the white wheats, which he had usually sown. In the beginning of February 1804, he sowed some of this sort of wheat after turnips in the same day and in the same field with some white Dutch wheat, and found the latter to be much more injured by the mildew, which he attributed to the stalk being so large and porous as to absorb in a greater degree the moisture of the dews, whereas the red wheat being a smaller and more solid stalk, and of course less porous, received but very little injury.

The writer states some facts, which he calls *material,* respecting the effects of mildew, in a piece of ground situated rather higher than some of the surrounding lands, part of it sloping towards the east, and having a descent from the north and south, forming a concavity, in which the wheat when sown after turnips, manured with lime and earth without any dung, has been always mildewed, as also many other smaller concave spots which are on the summit of the field, when the surrounding wheat on the higher level ground has not the least appearance of it, the straw being perfectly bright and yellow, while the other was almost black, insomuch that he separated one from the other by putting it into different stacks, being directed by the colour of the straw alone. He endeavours to account for this difference from the concavities in the field retaining the water much longer than the other parts, and of course being more damp and affording more vapour, whereby the plants so situated would in cold nights be surrounded by the condensed vapour, which would probably freeze on the stalk, thereby destroying the texture of it, and suffering the sap to escape, as well as causing too great an oxudation of the perspirable matter through the longitudinal cracks that are apparent in the stalk,

which would favour the growth of the fungus. If a thermometer was placed in one of these cavities, and another on the higher level ground, the former would be found to be the coldest situation, and for this we have the evidence of our own senses, as every man who has had occasion to go an hour or two after sunsetting in the summer from a high point of land, and pass over low swampy lands when a mist is over them, must have felt its chilling influence.

Since, however, seasons cannot be altered nor frosts prevented, Mr. Jones recommends the procuring such sort of wheat as is of the hardiest kind, and will ripen earliest, which may be acquired by selecting the most early ripe ears in the same field, and applying them to the produce of seed only. He thinks the higher latitudes in the north of Europe, more likely to furnish a hardy kind of seed wheat than North America; for though the winters are much colder there than in the same parallel of latitude in the north of Europe, yet their summers are much hotter, and the vegetation quicker, for the spring there advances with a degree of rapidity unknown to Europeans. The same thing is practised by both gardeners and graziers, for the former always wish to transplant fruit trees from poorer lands to better, and the latter would procure lean cattle from lands inferior to those on which they intend to fatten them.

Though it is commonly said that wheat when mildewed cannot be cut *too soon*, yet the experience of this writer has convinced him that the *proper time* depends on the progress it has made: he has known the first attack slight, penetrating only the outer bark of the straw in a small degree, and without any increased injury for many days, when it has appeared afresh on other parts of the stalk; and the parts first affected have been much more injured by the second than by the first attack, which he attributes to the stalk having been rendered more porous, and consequently more susceptible of the effects of a second frost, which accounts for the more rapid progress it makes in the later than in the earlier stages of the disease. Having erred at sometimes by letting his mildewed wheat stand too long, and at others by cutting it too soon, he determined to observe very particularly the progress of the mildew in 1805, in which year it was not so rapid as it had been in other seasons; and in order to ascertain the most proper time to cut it, he had some sheaves cut, and others pulled by the roots for ten days successively, and he found the difference in favour of the latter before the disease had penetrated to the middle of the stalk, but no difference afterwards; and he was convinced that the extra expense of cutting off the roots before it was carried, would be more than repaid by the superiority of the grain, in cases where there was a necessity for cutting it very green to stop the progress of the disease. The result of much observation and experience has convinced him that it is most advantageous to let the corn stand, till the grain becomes so solid as not to admit any

of the milky juice to be squeezed from it, provided the mildew has not penetrated *through* the stalk, but if it has, it will be of no use to let it stand longer, though some of the milk remain in the grain, because by drying it without being exposed to the heat of the sun, it may be hardened so gradually, that this milky juice will in a considerable degree, be converted into the farenaceous part of the grain. It is observed, that this may be accomplished by letting it remain on the ground, like barley, to receive the dews, but Mr. Jones has thought of a method of covering all the ears by laying the sheaves longitudinally on the ridge, after the reaper, covering the ears of the first sheaf with the second, and the second with the third, and so on, so that the ears of the last sheaf only remain uncovered; the third day after it was turned on the adjoining ridge, reversing the order of its lying, and taking care that the side of the sheaf, which had been under, should be uppermost; and in three days more it was stacked up in the usual way to be made sufficiently dry to be carried.

When the grain was threshed, the following results were obtained;—thirty-five sheaves of the wheat not in the least mildewed produced one bushel, weighing 61lb.; 42 sheaves of that which was mildewed, and after being cut, *laid on the ground and covered,* produced one bushel weighing 58lb.; 48 sheaves of that equally mildewed as that last mentioned, set up *in the ordinary way* produced one bushel weighing 55½lb. So that the wheat which had no mildew produced $\frac{1}{7}$ more in quantity than that which was mildewed, and after being out-laid on the ground and covered, besides three pounds per bushel heavier, and that which was covered though equally mildewed with that set up in the usual way, produced $\frac{1}{7}$ more, with the additional weight of 2½lb. per bushel.

The writer concludes by observing, that the knowledge of the *cause* of mildew is certainly of less importance than that of discovering a preventive of the recurrence of the evil, and a method of lessening its effects when it may occur; and he earnestly recommends an attention to the principles he has laid down with respect to the kind of wheat least liable to mildew, and the most proper time to cut such as may be affected, together with the subsequent management of it.

Observations.—This essay evinces much ingenuity in the attempt to ascertain the cause of a malady so destructive to wheat crops, as the mildew. The reasoning, by which the writer supports his opinion, that frost is the cause of mildew, is strictly philosophical; and if the enquiry was mere matter of amusement, the conclusion might safely be adopted without farther experiment. But when the regular supply of bread corn is liable to be affected by this disease, that should not be taken on conjecture, which may be proved by observation and experiment, and surely observation and experiment, if accurately conducted, with the assistance of the thermometer might ascertain whether in any

particular field the mercury ever sunk, during the nights of the beginning of August, below the freezing point. The theory suggested by Mr. Jones would then point out whether the corn ought, or ought not to be mildewed; and the fact would probably either confirm or shake the hypothesis. It will be seen from another paper noticed in our ninth number from the Communications to the Board of Agriculture, that *spring wheat* is never affected with this disease; and yet it does not ripen earlier than winter wheat. Why this difference should take place, if frost be the cause of mildew, it is not easy to determine, for the one kind must be equally exposed to the influence of the frost as the other. The harmless barberry tree is, however, at last acquitted of producing the baneful effects so long and so unjustly imputed to it. Even if Mr. Jones's hypothesis as to the cause of mildew be erroneous (which, however, we do not assert) his directions as to the best time of cutting, and the proper mode of treating mildewed grain, will be gratefully acknowledged by every intelligent and discerning husbandman.

On the Improvements to be effected in Agriculture by the Extirpation of Weeds.—By Mr. William Pitt, *of Wolverhampton.—Communications to the Board of Agriculture, Vol. 5.*

This essay commences with the observation that the cleaning of all kind of crops, and keeping them free from weeds, is an essential part of cultivation, which, if omitted, neglected, or but partially performed, a part of the cultivated crop will be lost; for as the ground can only afford a certain portion of nourishment, and as the nourishment drawn by the roots of all vegetables is somewhat similar, where that nourishment is suffered to be drawn by weeds, it is lost to the intended crop. And this observation is not confined to corn only, but will apply to pastures, to hedges, and plantations, and to all parts of the earth's surface, occupied and cultivated for the use of man. The cleaning of a crop from weeds, it is observed, must be effected in two ways; in the preparation, and during the growth of the crop. In the preparation attention must be given to distinguish root-weeds from seedlings, as their destruction must be effected by different principles. And as the vegetables, which we term weeds, are more hardy and tenacious of growth than any other, so the opposition to them must be applied more steadily and resolutely.

Then follows a division of weeds into annuals, biennials, and perennials, and a long list or catalogue of them (for which it is necessary to refer to the original article) as they have been observed by the writer, growing in, 1. gardens; 2. corn-fields; 3. meadows and pastures; 4. waste and uncultivated land; 5. hedges; 6. woods and plantations; with some observations on the injurious tendency, methods of extirpation, and instruments made use of for that purpose.

GARDENS, he remarks, have many weeds introduced into them from seeds wafted by the wind, as well as by using raw dung, particularly of hogs or horses, which often contain seeds possessing their vegetative power, and the litter intermixed therewith often contains more. Much labour, however, in weeding, may be saved by attention, in drawing up all seedlings in time, and before they have sown their seeds; for the increase of weeds in this way is beyond calculation. The tools principally used in Staffordshire, (where Mr. Pitt resides) for destroying weeds, are the spade, the three-fanged fork for cleaning out root weeds, and the different kinds of hoes for cutting up weeds, moulding up plants, and loosening the surface.

With respect to CORN-FIELDS, Mr. Pitt adopts the observation of Dr. Anderson, "that there is only one mode of extirpating annual weeds, whose seeds are indestructable; and that is, to put the ground in such a state as to induce them to germinate, and then to destroy the plants." In order to accomplish this in the most effectual manner, he thinks the ground should be ploughed before winter, but not harrowed; as soon as it becomes dry in March it should be cross-ploughed, and harrowed down; many of the seeds and roots will then vegetate, which should in due time be ploughed under, and the land harrowed again, and this process repeated as often as is necessary; for this is the true use of a summer fallow, which is ineffectual for the destruction of weeds, if not attended to early in the season. The cultivation of turnips is peculiarly adapted to answer this purpose, as an early cultivation is then indispensably necessary. It is observed that the destruction of root-weeds is to be accomplished by working them out of the soil in dry weather only, and the destruction of seedlings by pulverizing the soil, so as to induce the seed to germinate after rain, and afterwards ploughing under the young plants.

He considers it so very imperfectly settled what are weeds in GRASS LANDS, that it is impossible to frame a list in which the opinions of agriculturists will coincide; those, however, which are universally allowed to be noxious plants should be eradicated with the greatest care either by cutting them, or drawing them by the roots, which ever tends most completely to their destruction.

Though the weeds on WASTE LANDS are not numerous, he yet considers the improving them, as a sheep walk, an object worthy of attention.

All kinds of weeds are very injurious to HEDGES, which require to be well cleaned for the first three years after they are planted, to prevent the young quick from being choaked and destroyed; and as many of the weeds which grow in hedges are very destructive to the adjoining fields, by scattering their seed, they should be carefully eradicated.

Weeds in WOODS AND PLANTATIONS should be carefully removed while the trees are young, to prevent them from stealing away the limited nourishment which the earth affords to plants;

and he recommends the grubbing all such plants as are injurious to the growth of timber, such as briers, ivy, &c.; and that when timber trees in a plantation increase in size, they should be gradually thinned by weeding out the underlings and inferior species, and that annually, as the making too large an opening at once would let in too much cold air, and starve the plantation.

Observations.—This paper of Mr. Pitt's is extremely interesting, as it contains a complete catalogue of all the weeds which impede the labours of the husbandman and horticulturist, and destroy the hopes of the planter. It is the first attempt to class them, as they are respectively injurious to the different productions of the earth; and the length of the paper will not be condemned by those who study the theory of plants, for the sake of introducing agricultural improvements. To have attempted to have given the list of weeds in any one class would have been an imperfect account, and to have enumerated the whole would far have exceeded the limits which can be allowed in this publication to the notice of a single article. We therefore refer the curious to the original paper (which has been copied at length into the Repertory of Arts) with full confidence that it will repay the trouble of an attentive perusal.

The same volume contains also an essay by the same writer, "on the production and consumption of grain in Great Britain; its population at different periods; the means of increasing human subsistence, and of preventing future scarcities," which evinces much elaborate research, diligent investigation, and a cultivated mind. It is a very valuable paper, but as its subject is "*Political Economy*," and not "*Discovery or Improvement*," the analysis of it would not be within the province of the RETROSPECT.

Receipt for killing Rats and Mice—By A.F.—*Farm. Mag.* No. 32.

AFTER premising how very destructive rats and mice are to corn in all its stages, the writer submits a receipt for killing them, which he found among the papers of a deceased friend, without pledging himself for its efficacy, as he had no opportunity of making the experiment.—It is directed to take one pound of apuoka, and to boil it in two pints of ale till reduced to one; then to bottle it up, and put in an ounce of tincture of valerian; and to shake the mixture every morning for a month. When both rats and mice are to be killed, an ounce of the mixture is to be put among four pounds weight of oatmeal, adding thereto twelve drops of lemon essence: if mice in particular, an ounce of oil of sassafras should be added, and the quantity of lemon essence increased to twenty drops; and one drop of tincture of musk to a pound of the mixture is stated to be sufficient to attract the vermin. The most

cautious attention is inculcated in boiling the apuoka in the beer, as the steam arising from it is represented to be inevitably fatal.

It is also asserted, that stacks may be kept clear of rats and mice, by the following means: dissolve one pound of alum and one pound of nitre in two Scotch pints of spring water; then make a mash with bran, putting in two pints of this mixture to a firlot of bran: when the stacks are building, a handful or two of this mash is to be scattered between every second course, as high as the eves; and it is stated, that if they stand twenty years, no rats or mice will come near them.——This is given as the *genuine* receipt for destroying rats and mice.

Observations.—The depredations committed by the noxious vermin, whose destruction is here plotted, is so great in many instances, that the farmer grudges no expense to be rid of such troublesome depredators. When the quality of the principal ingredient of the first receipt is considered, there cannot remain a doubt but it will bring certain destruction upon whatever swallows it; but the danger which arises from the fumes during the preparation will ever be an obstacle to its general use; and indeed the vessels employed in making and preserving it, are not free from danger, if used for culinary purposes afterwards. The last receipt merits a very extensive trial, both on account of its innoxious qualities, and the small expense of preparing it. And if it be found as offensive to rats and mice as it is represented to be, by the universal application of it they may be banished out of the country. But its *efficacy* is yet to be ascertained by repeated experiments.

Concerning Free Martins.—By A. M.—*Farm. Mag.* No. 32.

The writer taking notice of a paper in a preceding magazine, (an account of which will be found in the second volume of this work, p. 542) asserting that the female of cattle, when twin with a male, is incapable of propagation, gives an instance of the contrary to his own knowledge. On the 11th of November, 1804, a cow of his brought forth two calves, the one a bull, the other a cow calf, and in the last spring the female twin produced a good male calf: she had indeed offered for the bull earlier, but was not attended to. He adds, that a neighbour of his had a female twin, who would never take the bull, and was in consequence at five years old sold to the butcher.

Observations.—As the question whether a female twin, when brought forth with a male, is or is not capable of propagation, remains to be ascertained by continued observation, this paper is noticed for the same reasons as induced us to insert the preceding one on the same subject.

On the Culture of Carrots—By the Rev. F. ELDRIDGE.—*Communications to the Board of Agriculture,* Vol. 5.

THIS paper commences with an observation that Mr. Arthur Young in his Farmer's Calendar has entirely overlooked the use of the carrot, for which reason he thought it right to communicate his sentiments to the Board of Agriculture, as they were the result of six years experience. The writer resides at Bonvilstone, in Glamorganshire, and in the year 1800 being in want of grass for a little Welsh cow, as all his land was for hay, and having ten beds of carrots in a new garden, he had the tops of the carrots mowed off a little above the crown, so as not to injure by the scythe the head or crown of the carrot, which proved a luxuriant food for the cow, and caused her to give more milk than she had done before. The carrot yielded another fine green head, which was treated in the same manner in October, and when the carrots themselves were taken up, they were equally as large and as heavy as those in a bed which had not been cut. The gardener was at first averse to cutting off the tops, but was subsequently convinced that it had not injured the root, and he had a better opportunity of hoeing and cleaning them from weeds, than when their tops were on them. These experiments are adduced as a proof that the agriculturist who grows a quantity of carrots, loses a great quantity of most excellent fodder for his cattle by not mowing the tops of the carrots twice in the year. Mr. Eldridge has no hesitation in stating, that a good crop of ten acres of carrots, by being mowed, will keep ten cows in good green fodder from the beginning of June to the end of October, and that the root itself will be found a very useful food during the winter months, for its richness causes a greater flow of milk, and also creates a sweetness in the milk, which grass unmixed with the Dutch clover does not produce. Horses and pigs will eat carrots with avidity, and thrive well on them; and gentlemen wishing to keep their game in nurseries will, by sowing carrots round the nursery, find that the hares and rabbits will feed on them in preference to any other food, and will therefore be always at home, instead of straying to a distance by night for their necessary provender.

Observations.—We do not recollect to have met with any account of the application of the tops of carrots for provender, before this communication of Mr. Eldridge, but the root is very generally applied to the purposes for which he recommends it, and we see no reason to doubt that all the advantages he mentions may result from mowing off the tops. The practice of sowing carrots for the use of game has been many years adopted by Lord Suffield at Gunton, in Norfolk, who possesses it on his manors there in greater abundance than any other nobleman in that sporting county.

On Pruning Fir-Trees. By Mr. Robert Salmon, *Woburn.—Transactions of the Soc. of Arts*, Vol. 24.

The silver medal of the society was given to Mr. Salmon, for his Paper of Remarks on the Pruning of Fir-Trees, in the year 1806. He is entrusted with the management of the extensive fir plantations of the Duke of Bedford, in the neighbourhood of Woburn, and his experience and opportunity of making experiments entitle him to much attention. He thinks that all firs should be planted thick, not more than four or five feet asunder, and there is less loss of plants from one sort overgrowing and destroying the others, where firs of the same kind are planted together; and prefers the Scotch and the Larch, if any mixture be at all admitted: he conceives, however, that in all plantations it may be right to have a few spruce or other sorts on the outside to prevent damage from sudden gusts of wind.

From much observation on pruning and its effects, it appears to him that fir-trees at a certain age should be pruned to a certain height, and the following simple rule is recommended: the pruning to commence when the trees are six years old, or when there is discernable five tier of boughs and the shoot, the three lower tiers are then to be cut off; the trees then to be let alone for four or five years, at which interval the pruning is to be repeated, and so on in succession, till the stem of the tree be clear to forty feet high; after which the pruning may be left to nature: the rule for the height of pruning after the first time to be half the height of the tree, and as many feet more as it is inches in diameter, at four feet from the ground: the proper time between September and April; and the tool to be used, the saw. This pruning he considers not to be excessive, and believes the rule calculated to check the too tapering top, and strengthen the bottom, as the trees will at the top be clothed with somewhat less than half their branches. He recommends the regular thinning of plantations so as that the distance of the trees from each other may be equal to one-fifth of their height, as nearly as order and regularity will admit of this modification. He points out in a very strong and convincing manner the necessity of cutting off the branches, and removing all broken arms, close to the body of the tree, because the dead knots are extremely prejudicial to the timber, and these will invariably arise where boughs are severed at a distance from the trunk, as all the remaining part of the arm dies away. This was proved and illustrated before the Society, by various specimens which he exhibited; but this illustration cannot be fully explained without the assistance of a plate, which accompanies the original paper. The objection of the expense is obviated by the assertion that the produce of trimming only doubly repays the whole cost. And he has no doubt but that as pruning substitutes

clean wood for knots on other trees, the same effect will be produced on the fir by the same treatment, and entertains a well grounded expectation, that by care and culture English fir may be rendered equal to foreign, for all the purposes of building and carpentry.

Observations.—The cultivation of the fir-trees does not appear to have received in this country all the attention which its usefulness demands. The improvement of the quality of this species of timber is certainly of the first importance, even in a national point of view, since the difficulty of obtaining supplies for our naval equipments from the shores of the Baltic are every year increasing. On these grounds particularly we recommend the perusal of Mr. Salmon's remarks to every planter and every gentleman of landed property, as there are many parts of the kingdom which may be applied to the cultivation of fir-timber, though the sterility of the soil prevents their being applied to any purposes of agriculture. The extensive heaths and warrens in Suffolk and Norfolk, which afford but a scanty subsistence to the only animal which traverses them—the rabbit—would be more profitably employed both to the proprietor and the public, if covered with plantations of fir-trees, to which most of them, from their warm sandy soil, are excellently adapted. We are not, however, so sanguine in our expectations as to look for English fir equal to that of the Baltic. The difference of climate makes a great difference between the oak of Great Britain and the oak of the North of Europe; and the same cause may be expected to produce similar effects on the fir. But if the fir can be so extensively cultivated as to furnish every necessary for the purposes of common building, it will be a great public advantage, as by these means more of our native oak will be left at liberty to be applied to the uses of our Navy, which is at once the pride and the safeguard of the Nation.

On the Culture of Hemp.---By Mr. Philemon Wright, *of Hull, in the County of York, in Lower Canada.—Transactions of the Society of Arts,* Vol. 24.

This gentleman cultivated ten statute acres of hemp annually in the years 1802, 1803, and 1804; but owing to the great drought in 1804, the crop was unproductive, reducing the medium produce of the three years to about six hundred weight per acre of clean dressed hemp of the first quality. He sowed his hemp by the broad-cast method, at the rate of three bushels of seed to an acre; the land, which was of a rich gray loam, having been previously ploughed thrice and harrowed, was again harrowed after the seed was sown. He commenced pulling the male hemp about the first of September, laid it in rows to dry, and when it had received one day's sun, turned the rows over with a short

pole, and suffered them to remain till they became perfectly dry: he gathered them up in fair weather: and bound them with willow withs into bundles of two feet and a half circumference, and then piled them into stacks, which were covered with straw to protect them from rain. The process of maceration was performed in stagnant pools of water about three feet in depth, where the bundles were sunk in rows to at least two inches below the surface of the water, and suffered to remain there from seven to nine days in September, and from sixteen to eighteen days in October, as the necessary time depended on the temperature of the water. When the hemp peeled and separated easily from the stalk it was taken out of the water, and drained, and then spread out thinly that it might dry thoroughly, after which it was again bound in bundles and stacked as before, until leisure admitted the dressing it. If the bottom of the pool was muddy, poles were laid under the hemp to prevent it from coming in contact with the mud, but this precaution was unnecessary where the bottom was sand or gravel. Some of the hemp was treated differently; after the water had been drained from it, the bottom of the bundle was opened, and it was then set up against pales or rails, till the months of April, when it was found to dress much easier, for the action of the frost and air had destroyed the glutinous matter, which is the greatest obstacle in dressing, and had thereby facilitated the separation of the hemp from the pith or woody substance: this method appeared to the grower to be attended with good effect, and a great saving of manual labour. The hemp macerated late in the season was found tough, and difficult to dress, from not being sufficiently dried, and was consequently attended with great waste; but by keeping such hemp till the second winter, it was proved that a man would in any given time dress double the quantity. In dressing by hand three heavy breaks were used in succession, the first bearing two grooves, the next four, and the third the same number but more compact.

The female plant, or that bearing seed, was suffered to stand until fully ripe, usually the first week in October, when that was also cut; and after lying two days in fair weather, was turned till sufficiently dry, and then threshed out with a common flail upon cloths, or upon a trodden level space on the field, and winnowed, and laid up as speedily as possible. The hemp was then treated the same as the male hemp, but the produce was much inferior in quantity and quality.

Observations.—The importance which the cultivation of hemp is soon likely to assume in this country, has made us more minute in describing the detail of its cultivation in Canada, than we should have otherwise been in this article. The great consumption of hemp for the naval purposes of the empire, must soon render this plant an object of common agricultural attention, if the shutting the ports of the Baltic preclude farther importations from the

North of Europe. The cultivation of hemp appears to us likely to become, not only a necessary, but a profitable speculation to agriculturists; for if it can be grown in Canada, when the price of labour is not less than a dollar per day, which is equivalent there to a bushel of wheat, with a very considerable profit, surely it must be worthy the attention of the English farmer, even in a pecuniary point of view, and more particularly of the farmer in Ireland, where labour is yet much cheaper. There are many uncultivated districts in Ireland particularly adapted to the cultivation of hemp, and perhaps none more so than the immensely extended bog of Allen. This useless and pernicious waste, which at present breathes only disease and pestilence, might by draining and appropriating to the culture of hemp, afford a supply of that valuable article sufficient for the use of the whole British Navy.

On the Improvement of a Moor.—By Mr. William Cheetham.—*Transactions of the Soc. of Arts*, Vol. 24.

This gentleman obtained the silver medal of the society for his improvement of a considerable extent of land, a part of Mellor Moor, near Chapel-in-le-Frith, in the county of Derby. He first drained the moor-land by main and cross drains, and then turned it over with the breast-plough, where the surface would admit of it, and in other parts with the spade and the pick-axe, and reduced it as nearly as he could to a level surface; the peat he burned, and spread the ashes on some parcels, on others he laid lime at the rate of two hundred and fifty bushels to the acre; and some parts he endeavoured to bring into good turf by management and manuring, without disturbing the original soil. A space of from five to ten acres was allotted to each respective method. His first crop in all cases was oats; and immediately after the crop was got in, he again ploughed the land, and left it in that state till the following spring, when he sowed it with oats as before, and found that by ploughing in the autumn much labour was saved, as a single harrowing was then sufficient in the spring; and he obtained an extraordinary good crop. In the following season he ploughed the land in the same manner, and sowed a third crop of oats with hay seeds; the oats yielded nearly as before, and the hay seeds produced good meadow and pasture in a few years.

He greatly prefers the method of paring, burning, and liming, as well as ploughing in the autumn, to any other; as paring destroys the heath at the first operation, and prepares the land so that a team may come upon it in dry weather. From the experiments of liming and manuring with black dung upon the heath, he found that though the heath was eventually destroyed, yet it required from seven to ten years for the effect, and even then only an indifferent pasture was made; whereas by sowing oats and hay-seeds, a good crop was produced the first year, and on the following a much

better pasture was made than after the term of ten years by liming and manuring without ploughing up the soil.

Observations.—Much light has been thrown on the improvement of Moor-land by the accounts noticed in the two last numbers of the Retrospect, as well as in this article, and the Agriculturist would do well to consider the Welsh, the Lancashire, the Derbyshire, and the Scotch methods, before he commences improvements of this nature. In one point they all agree—the necessity of getting off as much water as possible by open drains—and the experiments of Mr. Cheetham confirm the opinion of others, that a good turf is sooner obtained by destroying the peat, and sowing hay-seeds after corn, than by any improvement of the original soil. His method of ploughing immediately after the crop is got in, is very excellent husbandry, and is equally applicable, and will be found equally beneficial to all rough land already in a state of cultivation.

An Account of a Drill Horse-Hoe, or Weed-Harrow. By J. C. Curwen, *Esq.*—*Trans. of the Society of Arts, Vol.* 24.

This implement, which is only applicable to drill husbandry, consists of a carriage with shafts, the wheels of which are intended to be half the width of the butts or stitches, so that once going up and once returning, will be sufficient to clear each butt from weeds. The hoe or harrow is attached to the carriage by two chains, and may be raised higher or sunk lower, or placed more on one side than another, by altering the position of the chains. Six double rows of teeth or knives are so placed in the frame of the harrow, that each double row may pass up the interval between the rows of corn, and cut or pull up the weeds that grow there; the harrow is also furnished with two handles, by which the person who holds them may direct the teeth of the harrow, and keep them in lines so as to prevent the corn being injured. Mr. Curwen states, that with this implement he gives his wheat crop two cleanings at an expense of somewhat less than a shilling per acre each operation; a man and boy with one horse being able to clean above seven acres in a day.

Observations.—This harrow of Mr. Curwen, which is as simple in construction, as it is useful in its application, is deserving of the attention of all Farmers who practise the drill husbandry. It appears to be perfectly efficient for all the purposes for which it is intended, and the expense of it is not too great to render its adoption very general. The difficulty and labour of cleaning drilled wheat crops, are easily obviated by this implement, and at the same time the soil is broke and loosened, so as to give a greater power of extension to the roots to the grain.

Produce of Milk and Butter from a Cow, the Property of WILLIAM CRAMP, *of Lewis, in the County of Sussex, for one Season, commencing the 1st. Day of May 1805; (the day she calved,) up to the 2d. day of April 1806.—Communications to the Board of Agriculture, Vol. 5.*

THE quantity of butter made from her milk during this period, was 540lb, which sold for 41*l.* 7*s* 0*d*; the milk, exclusive of cream, was 4381 quarts, which at one penny per quart was worth 18*l.* 5*s.* 1*d*; and five loads of dung were made during the season, which was worth 15*s.* per load, and amounted to 3*l*; so that the whole produce was 62*l.* 12*s* 1*d.*; and the expense of keeping her during the same period, was 21*l.* 6*s* 2*d*, giving a profit of 41*l.* 5*s.* 11*d.* She was fed during the summer on clover, rye-grass, lucern, and carrots, which were given three or four times a-day, with four gallons of grains and two of bran mixed together at noon, and in the winter, with hay, bran and grains given much oftener.

Observations.—A fine large cow nursed, as this animal appears to have been, may have produced the quantity of milk and butter here mentioned, but this single instance ought not to be taken as the criterion of the produce or profit of a herd of cows, kept for the uses of the dairy; nor can it be expected that the dairyman can pay them all so much attention, for he cannot be supposed to have so many idle hands to wait upon and nurse those, as the keeper of the House of Correction at Lewis, the office held by Mr. Cramp.

An Essay on the Influence of Frost, and other varities of bad weather, on the ripening of Corn. By the late BENJAMIN BELL, *Esq.—Transactions of the Highland Society, Vol. 3.*

IN this communication a variety of experiments, calculated to ascertain the end proposed, are detailed at considerable length. The attention of the writer, who has since paid the debt of nature, was first called to this subject in the autumn of 1782, when at the usual season of all the corn in the northern parts of Scotland being all got home, none of them were ready for cutting. From the experiments, most of which were above once repeated, he was led to conclude, that barley and oats may be exposed to much variety of bad weather, in every period of their growth, without being destroyed, and that they even continue to acquire additional weight, though exposed to severe cold, and even to frost; for which reason unripe corn ought not to be too hastily cut in late, from an apprehension of its being injured by the severity of the weather, and in order to judge of the effects of frost and other varieties of bad weather on corn, and

of the progress which it continues to make, he advises that it should be frequently examined with care and attention, so that none may be cut till the farther increase appears at an end. He is of opinion that corn does not suffer so much from frost either before it be cut, or afterwards, when the weather is dry, as from rain, and wet snow; and that the same holds good after the corn is cut, but it is soon destroyed when exposed to cold rain or snow, as wet not only renders barley totally unfit for malt, but exhausts the strength of every kind of corn which vegetates under such circumstances. But though corn acquires additional weight in almost every degree of cold, yet it is evident to him that exposure to frost renders it very unfit for seed; for while every seed of good corn will vegetate if placed at a proper depth in a good soil, a great proportion of seeds that have been exposed to the frost, never appear above the surface, and the plants of those which actually do vegetate, are so weak that the crop is both small in quantity and inferior in quality. And though it appeared from some of the experiments, that in using well-ripened corn for seed, the produce of the crop depended in a considerable degree on the weight of it, yet he did not find this happen in any sensible degree in corn which had been exposed to frost, for the plants arising from this were always weak, and the produce small. He found frost much more injurious to all leguminous plants, as pease, beans, and tares, than to wheat, oats, or barley, and that in every stage of their progress: and though all the grasses usually sown in Britain were much injured by frost, he found none suffered so much as the red, or broad-leaved clover. And he recommends that, though frost may not be very injurious to corn in the spring, yet none should ever be made use of for seed, which has been exposed to it in the autumn: even as a measure of economy, he advises that the best corn should be made use of for seed in the first instance, as of that which has been injured by frost nearly twice the quantity is commonly sown, that the ground requires of good seed, while the difference in price seldom amounts to one sixth part, and the crop seldom extends to a third of the produce of good seed. Instead of confining the practice of washing seed in brine and other saline impregnations to wheat only, he strongly inculcates the propriety of extending the same preparation to all other kinds of grain; for when light seed is used, the crops more readily suffer from blight and other diseases; and it appears to him that many diseases of plants, especially such as give rise to the generation of insects, are particularly apt to spread, and communicate the contagion to plants which are weak and debilitated. For the prevention of all these hurtful consequences, he recommends that none but the best seed of every kind should be sown, and such as has been well-ripened and uninjured by frosts, snows, or rains; and that the whole of seed-corn should be washed with strong brine, not wheat only, but likewise barley, oats, beans, pease, and tares; for nothing renders corn so fit for

seed as this operation, which when properly done, carries off not only the light seeds, but also the seeds of many weeds which cannot in any other way be so completely separated from it.

Observations.—The subject of this Essay is not more important than the information it contains. The experiments appear to have been conducted with the greatest fairness, and in the manner best calculated to throw light on the inquiry. The seeds which had been exposed to frost were most of them gathered under the immediate inspection of the writer, and the good ripe seed obtained from England by an eminent factor; and the conclusions were not from a single, but from repeated trials. The recommendation to wash *all seeds* in brine, or some strong preparation of salt or alkali, cannot be too strongly enforced. More seeds of weeds might be destroyed by this operation than would be eradicated at ten times the expense and trouble, after they had vegetated and sprung up.

Experiments on Manures. By the Editor.—*Annals of Agriculture,* No. 265.

These experiments are too numerous, and most of them too far removed from the probability of common practice, to deserve particular notice; the results, however, may furnish some information. Dry oat-straw was found to do mischief; old thatch less; but dry good hay was of considerable utility; these results were obtained in a dry summer, which prevented the straw from putrifying, but not the thatch and the hay: beech leaves were found beneficial, and all green vegetable substances, except laurel leaf and walnut shells, the first of which did mischief, and the last proved an entire poison; the effect of indigo was very great; of spirit of hartshorn not so great; of spirit of wine, mischief; but the greatest superiority was in favour of malt-dust.

Observations.—The experiments detailed in this paper are a continuation of preceding ones, which have been for many years occasionally recorded in the Annals of Agriculture, and are merely deserving notice as a continuation of the series: the only new circumstance is the discovery of the deleterious quality of walnut-shells when applied as a manure.

On Butter Churns. By Philator.—*Dickson's Agricul. Mag.* No. 3.

It is observed, that the object of churning milk or cream is by a certain forcible agitation to separate the unctuous from the serous particles; the former becoming butter, the latter whey. The less labour, therefore, required by any machine, supposing it equally efficient in other respects, the more decidedly it is en-

titled to a preference. Some remarks are then offered on the causes of delay in obtaining butter, which are all too well known to those to whom this article is likely to give information, to make it necessary to repeat them. The different modes of churning adopted by the Indians and the Tartars are next described, which consist of different modes of applying a horizontal motion of flashers fixed to a vertical churn-staff, which gives them motion. The most curious of these, as well as the most common in India, is obtaining butter in a large red earthen unglazed pot, containing thirty or thirty-five gallons. Its round bottom is kept in its place firmly, either by an excavation of the soil, or by means of a circular pad or band of straw, twigs, &c. The pot is placed close to a tree, or, if none be at hand, a strong stake firmly fixed; and two rope bands are passed round about a foot from each other, and long enough to enclose the stem or stake, and to reach over to the centre of the churn. The milk is put into the vessel to the amount of rather more than half its capacity, and agitated by means of a piece of bamboo, which is split at the lower end into four, six, or eight parts, which are all kept extended in a conical form by short pieces of wood, whose pointed ends are inserted into holes bored in the two opposite divisions respectively. This being immersed in the milk so as nearly to reach the bottom of the churn, one of the bands is put over it, then a thong of raw cow's-hide dried in the sun, of about six feet long, and an inch broad, is lapped three or four times round the bamboo, just above the lower band; and the upper band is applied over the thong, and the operator holding one end of the thong in each hand by means of short pieces of wood fastened to them, turns the bamboo with an alternate motion, in the same manner as turners on some occasions turn their work. The bamboo is kept perpendicular by the two bands, which resist the tension caused by the man's action in the thong, and the operation is further aided by his occasionally raising or lowering both hands, whereby the bamboo works higher or lower in the churn, and gives a more perfect circulation to its contents.

The writer considers the principle of this churn to be excellent, though from want of proportion it falls short of what it is capable of effecting. He observes, that in this mode of revolving the agitating power, the whole force of a man may be applicable, and that in a conical churn thus set to work an astonishing quantity of butter may be made; for the horizontal motion of the flashers or flyers, is beyond all doubt superior to that upon a horizontal spindle, on which the flyers have necessarily a vertical motion; in the former case the motion being equal in all parts, whether the quantity be great or small, and as the whole of the cream would be subject to equal agitation, all the butter must, under common circumstances, come at once. The rapid motion of the flyers, and that too being alternate, he considers of great advantage, especially in deciding those critical moments, when butter, though nearly

made, yet lingers in the whey, for want of sufficient power to agitate it in a manner as to force it to separate.

He thinks this principle might be applied on a small scale, by having a churn made with one foot treadle, where the spindle might be twined by an endless screw; or it might be turned by two foot treadles, and the spindle moved by a thong passing over two pullies, so that the motion would be alternate; in either of which cases the velocity would be regulated by the quicker or the slower pressure of the operator's foot, as in the common spinning-wheel, and similar machines.

Some observations are interwoven on the effects of mixing with other milk, that of a cow, who is desirous of the bull. In this case the writer has almost always found, and especially in the spring of the year, that a certain rank flavour was perceived in the butter, not unlike goat's milk cheese, and recommends that such milk be kept separate for the uses of the kitchen only, in which its imperfections are not discovered.

Observations.---This article on butter churns, though it is anonymous, is certainly one of the most valuable that has appeared in the publication from which it is selected. The principles of churning are explained with equal plainness and perspicuity, and are carefully attended to in the application of the machine recommended, which, however, appears more applicable to narrow churns than those of greater diameter. The necessity of constant change of place in the cream during churning is very obvious; when the churn is too full this change does not readily occur; when it is not full enough, it is more difficult to be effected. In barrel churns this evil cannot be altogether obviated, because whatever be the quantity of cream, the flashers or flyers, are always at the same distance, but in a standing churn the flashers have equal power to divide a small quantity of cream as a larger.

On the gathering of Apples, and Description of a Ladder for the Purpose. By R. Y.—Dickson's *Agric. Mag.* No. 3.

This anonymous writer having seen so much mischief done to trees of all ages by placing ladders against the boughs, endeavoured to discover a mode of gathering his apples without having recourse to it. He stretched a large canvas sail-cloth under the tree, with a strong twine at each corner, whereby it was fastened to the but-end of a pitch fork; the four forks were stuck firmly into the ground, three of them being equidistant, and the fourth rather nearer to the first; this position formed a kind of funnel to receive the apples. The gatherer mounted into this cloth, and dropped the apples into it, so that they rolled gently down into the basket. Finding the fruit gathered in this manner with much ease, and without damage as to bruises, he contrived a ladder expressly for

the purpose. The ladder itself is about eighteen feet long, and has two legs each of the same length fastened by iron joints to its top. When it is in use, these all diverge like the corner rafters of a triangular roof; and at about four feet from the ground a hook is fixed to each leg, and to the ladder, for the purpose of stretching out a triangular cloth, which ends in a funnel, like the hopper of a mill. The gatherer mounts the ladder, and throws the fruit as he strips it from the surrounding boughs into the cloth, from whence it rolls down the funnel into baskets, successively removed as they become full.

Observations.—This useful implement for apple-gathering recommends itself to the notice of the orchardist, not more by its simplicity than by its preserving the fruit from bruises, which is an important circumstance, whether the fruit be intended for cyder or for domestic purposes. The trees are also preserved from the injury too often done by placing ladders against the boughs. The use of the ladder recommended does not appear to be limited to the gathering of fruit, it may be equally useful for pruning standard trees of every description, both of the orchard, the ornamental plantation, and the rising forest.

On the Fly and Maggot in Sheep. By R. P.—Dickson's *Agricultural Magazine,* No. 4.

The writer is of opinion that under what is commonly termed a *fly*, a great variety of insects of that kind may be comprehended; some of which have the power of puncturing the skin, and which afterwards becomes enlarged and inflamed by the attacks of others. Sheep are said to be most frequently attacked, especially on their heads, where the pastures are in low situations, and much covered with wood of a bushy description; and in warm seasons there is much danger from slight wounds caused in shearing or otherwise: when accidents occur it is recommended to smear the parts with tar, or some similar application. The *maggot* is stated to be often fatal in a short time, when not well attended to, and cleared away on the first appearance: they are probably produced from the eggs of many different flies, though it is the common opinion that the large flesh fly, or blow-fly, has the principal share: and those parts of the animal, which are best adapted for the reception of the eggs, are most frequently injured. After describing the symptoms, which are too well known to be repeated, he proceeds to speak of the remedies, and remarks, that for a great length of time applications of the drying absorbent kinds, such as fresh slaked lime, and alum which has been burnt, were in use, as removing the moisture from the ulcerated parts. *Sheep-powder,* which he believes to be a mercurial preparation, has been introduced in some districts with success. He notices the introduction of coarse whale oil, (train

oil) the application of which is said to be very effectual, not only in healing the ulcerations, but in driving away and keeping off the flies, and he recommends the trial of it to the sheep-master. In respect to the maggot, he thinks the best remedy is to have the wool closely shorn from the parts affected, as far as there is any moisture on the skin, carefully clearing away the maggots, and destroying their nests, and after washing the ulcerated parts with a mixture of stale urine and soft soap, to apply a plaister of sulphurated ointment all over the part. By these means he asserts that much benefit has been derived, but reminds the reader that the constant eye of the shepherd is requisite to notice the first attacks.

Observations.—Though the remarks in this paper have no claim to novelty, yet many of them are very useful, and are always seasonable, because the subject is recurring continually. Train, or whale oil, which is recommended by the writer, has been extensively applied in some districts, and though not a certain remedy against the *fly*, approaches nearer to it than any other application yet in use. The remedy for the *maggot* is ever effectual, but the application of it disfigures the animal.

On Cyder made from Wind-fall Apples. By a Devonshire Man. —Dickson's Agricultural Magazine, No. 3.

The circumstance that Stum (a name given by cyder-makers to the expressed juice of the apple) from wind-falls, will neither head so well nor keep so long, as that pressed from full ripe fruit, forms the subject of this paper. The cyder made from wind-falls is stated to be an unwholesome beverage, but capable of being much ameliorated by putting into each cask when filling a good large piece of toasted bread browned all over, which not only amends the flavour greatly, but gives the stum that disposition to an equable fermentation, which is with difficulty raised in wind-fall cyder, and carries it through the first stages wherein it is most liable to fail. This method is said to be recommended from long experience of its beneficial effects.

The writer claims the greater attention to these remarks, because it is the general opinion of medical men, that numberless complaints may be traced to that unwholesome deleterious beverage—cyder made from unripe apples—and thinks that some hints may arise for the diminution of this evil by a reference to the manner in which lime-juice is prepared abroad, so as to ensure its keeping well in bottles, without acquiring that musty smell, which renders it extremely unpalatable. The limes are sqeezed by a pair of wooden pressers, like nut-crackers, and the liquor is boiled until the scum ceases to rise, when a very small lump of alum is put in, which assists in clearing it: as soon as

cool, it is bottled very tight, taking care to pour off no sediment. Another method is, to strain the juice through bags of flannel of many doubles, till it be perfectly clear. It is asked, "Have the processes of boiling or straining ever been applied to cyder, and with what effect?"

Observations.—The importance of obviating the deleterious qualities of that cyder which falls to the share of the labouring classes in the cyder counties, has been the principal inducement to noticing this article, as the suggestions it conveys may reach some readers who would not have seen the original paper. The improvement of the crude liquor from wind-fall apples, by putting toasted bread into the stum, is very easy and unexpensive in practise; and that it produces some amelioration is asserted from experience. The mode adopted abroad for preserving lime-juice may be extended in its application to many native vegetable acids, if it should not be found successful in improving the juice of the unripe apple.

On the Disadvantages of Cultivating Hops extensively, and other unprofitable Systems, which are pursued in Herefordshire. By J. B.—*Dickson's Agricultural Magazine*, No. 4.

The writer observes, that Herefordshire is a fine rich and productive district, capable of producing luxuriant crops of almost every description, but from the prejudices of the cultivators and their adherence to old systems, the soil is much less fruitful than it is capable of being rendered. He notices a very prejudicial custom, upon which he bestows the appellations, absurd and cruel, the custom of cultivating the same arable land, for centuries, without the least change or variance of rotation; while other land is perpetually assigned to coarse pasture, the growth of alders to supply hop-poles, or to the cultivation of hops themselves. He asserts, that hops in Herefordshire at least, are by no means a profitable crop, and grounds his assertion on the following calculation:—The customary acre of hop-land, for rent and taxes, is rated at 30*s.* per acre, poles renewable in five years at 6*s.* ploughing, working, tying, drink, &c. at 36*s.* expense of picking, &c. to the time of selling the article 50*s.* per cwt. or 6*l.* 5*s.* per acre for 2½cwt. which is the usual produce of a ten years average, planting once in nine years at 10*s.*; which with the necessary manure, tythe, and attendance, cause an expense of twelve pounds ten shillings an acre; while the produce of 2½ cwt. the average crop for a term of years, at five guineas the cwt. (a greater price than they have borne for the last ten years together) leaves for the profit of a statute acre, twelve shillings and sixpence. He adds, that the contemplation of such facts as these, added to the neglected and wilderness appearance of the lands, and

the lowness, and (whenever hops fail) ill payment of rents throughout the county, forcibly point out the necessity of some new system of Agriculture into Herefordshire, which may be at once more beneficial to the land-owner and the land-occupier.

Observations.—It is generally admitted that the Agriculture of Herefordshire is far behind that of most other counties in point of improvement; the chief attention having been directed to live stock, both by the farmers in general, and the Society established at Hereford. The expense of cultivating hops must either be laid too high, or the average produce too low in this communication, or it is scarcely credible that the culture of them would be persevered in. In this county all other operations of agriculture are considered as subservient to hops, and neglected when this favourite plant requires attendance. The publication of complaint is, however, frequently the forerunner, and the cause of improvement.

On the Construction of Wheel Carriages used in Husbandry. By J. S.—*Dickson's Agricultural Magazine*, No. 4.

It having appeared strange to this writer, that amidst the many improvements daily made in agriculture, wheel carriages should be still loaded with many incumbrances perfectly unnecessary, adding much to the load, and impeding the draught to a considerable degree; to obviate these inconveniences, he recommends an improved cart, which he found from long experience to answer every purpose on a farm, as in carrying manure, earth, gravel, &c. and with additional ladders to be equally useful in the harvest. This cart should be made with moderately low wheels and iron arms, which are much stronger than wooden arms, easier to load and draw, and in the end much cheaper from their duration. The wheels should be cylindrical, and the rims a flat surface of four inches, with sloping side-boards, being so calculated as to carry a large bulk of loose grain and hay. With respect to waggons, he thinks the construction of those used in the counties of Gloucester, Surrey, and Sussex, most convenient for harvest work, because they carry their loads wide and low. But where it is necessary to carry soot-ashes and lime for manure, the body or chest of the waggon should be made about twelve feet long, and two deep, with side-raves to take on and off in harvest. He recommends the hind wheels to be not more than four feet eight inches in height, and the fore wheels four feet with iron arms, which will make the waggon light to draw and easy to load; he has himself adopted a waggon with all the wheels four feet four inches high, having cylindrical four inch tires rolling on a flat surface, and has found this implement equally light in the field and on the road. He considers three carts and one waggon suf-

ficient for the cultivation of 300 acres of arable land, if the lands do not lie far from the homestead, and except in hilly countries, where an additional cart and waggon will be necessary. He conceives a great number of carts and waggons to be rather matter of convenience than necessity, and that any farther expense is rather calculated to benefit the Smith and the Wheelwright, than the farmer himself.

Observations.—The waggon and cart with cylindrical wheels of a four-inch surface, as here recommended, are certainly very well calculated for agricultural purposes, and where the public roads are good, are more easy of draught than three inch wheels; but they do not seem adapted for those parts where the roads are cut into deep ruts by three inch wheels, for those recommended being an inch wider, would experience a considerable degree of friction on the sides, which would more than counteract any other advantage. Much information on the subject of broad wheels may be found in two reports of a Committee of the House of Commons on that subject, which were noticed in our last number, page 355.

Description of a new invented Drag, with four Truck-wheels; whereby it may be set to any Depth, and be easily transported. By P. L.—*Dickson's Agricultural Mag.* No. 4.

The implement here described differs from the drag-harrow in common use only in the circumstance of being placed upon wheels. The axis of each of the four wheels is fixed to a bar of wood, with a segment of iron at the other end. This bar is fastened on a pin to the side of the drag, and the segment passes through the side itself, and by being pinned higher or lower causes the bar to remain more or less oblique; by which means the teeth of the drag may be raised above the ground entirely, or may be made to take hold in it at any depth. When it is raised above the ground, it may be drawn from one field to another with much convenience, or as the writer expresses it, "easily transported."

Observation.—The addition of wheels to the drag-harrow, will certainly be found very convenient in many instances, but all this might have been obtained by the more simple method of fixing the axle of the respective wheels to a perpendicular bar of iron passing through the side of the harrow, which would equally admit of elevation or depression, and be less liable to be out of order.

On the Culture of the Potatoe, as a Food for Cattle and Swine. By Mr. John Saunders.—*Dickson's Agri. Mag.* No. 4.

This gentleman has frequently written on the cultivation of this very useful root, as well as many other correspondents to the different agricultural publications. Valuable suggestions and use-

ful information may doubtless be gleaned from many of these papers, but the whole subject has not only been *once dressed* and served up on the tables of the agricultural readers, but has been also set before them in every form of *hash*, which could possibly be invented, and it is too much to have the same subject *warmed up* again without even any novelty in the sauce. Till something new appears, "the culture of the Potatoe" will in future be passed over. It may, however, be proper to add, that the best essay on the subject is that by the Reverend Edmund Cartwright, which was published in the last volume of the Communications to the Board of Agriculture, and has been noticed in a former number of the RETROSPECT.

On the general Mode of rearing Turkies. *By* YORICK.—*Dickson's Agricultural Magazine.* No. 4.

THIS paper is an attempt at *pun* and *point*, in which the writer has succeeded most miserably. He affects to follow the language of Sterne, but it is at an immeasurable distance. The only valuable observation in it is, that turkies so far from requiring all the care and nursing usually bestowed upon them, would succeed much better if left to themselves in the open air; no bird is more impatient of heat. The turkey is found in its wild state in a climate where the cold is far more intense than in Britain, even in a sharp winter; a circumstance not sufficiently attended to by those who raise this delicacy for the table.

HORTICULTURE.

Observations on the Method of producing new and early Fruits *By* THOMAS ANDREW KNIGHT, *Esq. F. R. S. &c.*—*Horticultural Transactions*, Vol. 1. Part 1.

IT is observed that, as every species of fruit acquires its greatest state of perfection in some peculiar soils and situations, and under some similar mode of culture, the selection of a proper soil and situation must be the first object of the improver's pursuit, and nothing should be neglected which can add to the size, or improve the flavour of the fruit, from which it is intended to propagate. And though attention to these points will in almost all cases be found to comprehend whatever is necessary to insure the introduction of new varieties of fruit of equal merit with those from which they spring; yet the improver, who has to adapt his productions to the cold and unsteady climate of Britain, has still many difficulties to contend with; he has to combine hardiness, energy of character, and early maturity with the improvements of high cultivation. He conceives that every plant and animal adapted to the service of man, is made susceptible of endless changes; for if two plants, or any other tree of similar habits, or even cuttings of the

same tree, were placed to vegetate during several successive seasons in very different climates; if one were planted on the banks of the Rhine, and the other on those of the Nile; each would adapt its habits to the climate in which it was placed; and if both were subsequently brought in early in spring into a climate similar to that of Italy, the plant which had adapted its habits to a cold climate would instantly vegetate, whilst the other would remain perfectly torpid; and a plant accustomed to the temperature of the open air will vegetate strongly in December, whilst another plant of the same species, and sprung from a cutting of the same original stock, but habituated to the temperature of a stove, remains apparently lifeless. It appears to him, therefore, that the powers of vegetable life in plants habituated to cold climates, are more easily brought into action than in those of hot climates, and that their seedling offspring have a constant tendency to adapt themselves to any climate in which art or accident places them. But he thinks the influence of climate on the habits of plants will depend less on the aggregate quantity of heat in each climate, than on the distribution of it in the different seasons of the year, and observes, that the aggregate temperature of England, and of those parts of the Russian empire, that are under the same parallels of latitude, probably does not differ very considerably; but in the latter the summers are extremely hot, and the winters extremely cold, and the changes of the temperature between the different seasons are sudden and violent. The Crab is a native of both countries, and has adapted alike its habits to both; the Siberian variety, introduced into the climate of England, retains its habits, expands its leaves, and blossoms on the first approach of spring, and vegetates strongly in the same temperature in which the native crab scarcely shews signs of life. Similar causes are productive of similar effects in the habits of cultivated annual plants: thus the barley, grown on sandy soils in the warmest parts of England, is always found by the Scotch farmer, when introduced into his country, to ripen on his cold hills earlier than his crops of the same kind do, when he uses the seeds of plants which have passed through several successive generations in his colder climate; and the writer of this communication has found in his own experience, that the crops of wheat on some very high and cold ground which he cultivates, ripens much earlier when he obtains his seed-corn from a warm district, and gravelly soil which lies a few miles distant, than when he employs the seeds of his immediate vicinity.

The value to the gardener, of an early crop, has attracted his attention to the propagation and culture of his earliest varieties of many species of our esculent plants, but as few efforts had been made to bring into existence early varieties of those fruits, which are not generally propagated from seeds, Mr. Knight made some attempts to produce early varieties of fruit, and though the result of them was by no means sufficiently decisive to prove the truth of the hypothesis he was endeavouring to establish, or the eligibility

of the practice he had adopted, yet as he deemed it sufficient to encourage future experiments, he communicated it to the Horticultural Society.

The first species of fruit which he subjected to experiment was the apple; some young trees of those varieties of this fruit from which he wished to propagate, were trained to a south wall, till they produced buds which contained blossoms. Their branches were then in the succeeding winter detached from the wall, and removed to as great a distance from it, as the pliability of their stems would permit; and they remained in this situation till their blossoms were so far advanced in the succeeding spring, as to be in some danger of injury from frost: the branches were then trained to the wall, where every blossom, suffered to remain, soon expanded, and produced fruit, which attained in a few months the most perfect state of maturity; and the seeds afforded plants which have ripened the fruit very considerably earlier than other trees raised at the same time from seeds of the same fruit, which had grown in the orchard. In this experiment the fecundation of the blossoms of each variety was produced by the farina of another kind; from which process he thinks that he obtained in this, and similar experiments, a greater luxuriance of growth, but had no reason to imagine that the fruit ripened earlier on that account: the early maturity of the fruit he attributes to the peculiar circumstances under which the fruit and seeds ripened from which they sprang. By the same mode of culture he obtained many new varieties, which are the offspring of the Siberian crab, and the richest of our apples; and the plants thus produced seem well calculated in every respect to answer the object of the experiment, and possess an extraordinary hardiness and luxuriance of growth; the annual shoots of some of them from newly grafted trees exceeded six feet and a half in one season, and the blossom bore unfavourable weather without injury. In all these experiments he found that some of the new varieties inherited the character of the male, and others of the female parent, in the greatest degree; of some varieties (particularly the golden pippin) he obtained a better copy by introducing the farina into another apple, than by sowing its own seeds. He next turned his attention to experiments on the grape, which, though less successful than those on the apple, in the production of good varieties, are not less favourable to the preceding conclusions. His first attempt was to combine the hardiness of the blossom of the black cluster, or Burgundy grape, with the large berry and early maturity of the true sweetwater; the seedling plants produced fruit early, but the branches were short, and the berries small; substituting the white chasselas for the sweetwater, he obtained some varieties with very hardy blossoms, and the fruit of them ripening a good deal earlier than that of either of the parent plants; the berries, however, were smaller than the chasselas, and better calculated for the press than the desert; he also subsequently obtained plants from the white chasselas and sweetwater,

whose appearance is much more promising; but the earliest variety of the grape he has ever yet seen, sprang from a seed of the sweetwater, and the farina of the red frontignac. He has mentioned the varieties which have been most successful, because the propagator is frequently at a loss to know what kinds are best calculated to answer his purpose. He has likewise made similar experiments on the peach, but can say no more of the result at present, than that the plants possess the most perfect degree of health, and luxuriance of growth, and their leaves afford evidence of the good quality of their future fruit.

From a close attention to the subject for many years he concludes, that new varieties of every species of fruit will be better obtained by introducing the farina of one variety of fruit into the blossom of another, than by propagating from any single kind, and that, when the fruits are of different sizes, the farina of the smaller kind should be introduced into the blossoms of the larger; for he has generally observed a prevalence in the fruit of the character of the female parent; and the largest seeds obtained from the finest fruits, and from that which ripens most perfectly, and most early, should always be preferred. The period which must elapse before young trees sprung from seed become capable of bearing fruit, he believes cannot be shortened by any means; he holds both pruning and transplanting to be injurious, and thinks no change can be effected in the merits of the future fruit by either culture or manure at this period. The time, he observes, which different kinds of fruit-trees require to attain the age of puberty, admits of much variation: the pear requires from twelve to eighteen years; the apple from five to twelve, or thirteen; the plumb and cherry four or five years, and the vine three or four; the raspberry two years, and the strawberry, if sown early, affords an abundant crop the succeeding season.

Observations.—This very interesting paper would have afforded an additional proof, had it been wanting, of the extension of knowledge, for which horticulturists and naturalists are indebted to Mr. Knight. His small but valuable treatise on the culture of the apple and pear, first made him known in this department of research, and his subsequent discoveries and improvements in horticulture have placed him at the head of those who indulge in this branch of science, and who at the same time instruct and delight their countrymen. Nothing can be imagined more valuable to the gardener than to obtain new varieties of early fruits, which before could only be obtained by chance or accident, but may now be acquired by regular systematic culture. While the gardener has thus far been able only to propagate from the earliest plant he had discovered, the persevering industry and aspiring genius of this gentleman has taught the deducing effects from causes in the improvement of fruits, and has verified his theory by the result of experiment.

CHEMISTRY AND MINERALOGY.

Observations on mineral Coals. By Mr. PROUST.—*Journ. de Phys. Oct.* 1806.

VARIOUS specimens of coal left from 59 to 77 per cent. of coak. At present only thin veins of coals have been found in the Asturias, and those filled with pyrites; but the borer has not yet been used, being unknown in Spain.

Coal from Villa Nueva, near Seville, yielded about 6) per cent. of coak, 8 of oil, 4 of water, the remaining 19 per cent. was gaseous. Coal from Belmez, in Estremadura, yielded about 71 of coak, 10 of oil, 8 of water, and 12 of gas. Coal from Langreo, in the Asturias, yielded 75 of coak, 12 of oil, 4 of water, and 8 of gas. A specimen from England yielded 64 of coak, 7 of oil, 13 of water, and 16 of gas.

It appears, therefore, that mineral coals yield more than three times as much carbonaceous residuum as wood; and that they also yield more oil than the resinous woods. They also, on account of their containing azote, yield more heat than vegetable coals, by decomposing a greater quantity of oxygen.

The sulphurous smell observed when coals are burned arises from a mixture of pyrites, for if they are previously treated with nitric acid, they no longer yield this smell. The oil of coals is more or less fluid, and is said to preserve cordage, &c. better than vegetable tar, but this requires further inquiry. The finer oil is amberlike, and not disagreeable, it is speedily darkened by the air. The water contains a little carbonate of ammonia, but no acetous acid has yet been found in it; a small quantity of succinic acid was separated from it by muriatic acid. The gas burns with a white flame, and is very slightly diminished by lime-water.

Most naturalists have supposed that mineral coals are derived from vegetables submerged in the ocean, but this opinion is liable to many difficulties. Patrin, however, observes, that coals are found on the highest mountains of the globe; and we may add, that they frequently are found in alternate layers, with freestone, &c. for 50 or 60 alternations. The presence of vegetable impressions, or fossil wood, certainly indicate that the originals of these substances were then in existence, but the properties of the coal itself seems rather to approach those of animals than those of vegetables. It would be of importance to investigate whether the fossil wood contained in the coal strata yields the same large carbonaceous residuum as the coal itself. In the mean time, it may be remarked that mineral coals yield, when heated, an aromatic amber-like, smell, which does not irritate the eyes, or lungs, like that from vegetables. They melt and run together like the coals of mu-

cous substances, of resins, of indigo, of gluten, and of animal substances, and thus differ from those of any known wood. They yield a lighter, more aromatic oil, and more abundantly than the woods usually burned, much water and ammonia, but no acetous acid, which is so abundantly furnished by vegetables, and causes their smoke to be so very acrid. As this acid is constantly produced when oxygen forms a part of any organic body, it would appear that mineral coals do not contain oxygen. Coak burns slowly, and requires a strong draught of air, and thus also differs from vegetable charcoal. Again, coak treated with potash yields a Prussian ley, which few vegetable charcoals do. Nitric acid does not set fire to animal charcoals, nor to coak, as it does to vegetable charcoals; and the mixture of nitre with coak burns as difficultly as a mixture of nitre with animal charcoal. Most kinds of wood leave more ashes than is left by mineral coals, so that the latter are not, as some have supposed, clay impregnated with bitumen. Oxide of manganese is not found either in animal or mineral coals; the ashes of the latter contain much silica, a little magnesia, alumine and sulphate of lime, but, contrary to what is found in vegetable coals, very little carbonate of lime, and no phosphate or muriate. All animal substances contain sulphur, and mineral coals seem as constantly to contain pyrites, which are probably formed by the sulphur and iron of the organic substance that is bituminized.

All these observations require to be further examined, to see whether they extend to every known species of coal.

The carbonaceous principle of mineral coals seems very slightly combined with the other principles; for nitric acid at 18 or 20° digested for a few minutes upon coal from Villa Nueva, altered it so that it would no longer furnish oil, oily gas, or ammonia, but yielded other products, and only 66 or 67 per cent. of coak, instead of 68; a result which does not take place even with indigo, although that substance yields as much as 72 per cent. of charcoal. The carbonaceous residuum thus obtained from coals forms Prussian ley with alkalies, the same as ordinary coak. This slight adhesion of the carbone causes the black colour and fragility of coals. Yet they are not entirely deprived of hydrogen, or azote, but as the carbone is so condensed as to appear black, it cannot be combined with much oxygen, and therefore we need not wonder at the acetous acid not being formed by distillation. As nitric acid thus separates coak from coals, it seems to be contained ready formed in them; hence they do not resemble the organic bodies now found on our globe, none of which contain carbone deposited in their vessels, as if it were a fat, or resin: nor do any of these beings contain so large a proportion of carbone. Therefore, nature must either have produced formerly a race of beings with a greater proportion of carbone, of which coals are the remains, or else the submersion of the present race of organic bodies must have altered their composition, as it cannot be supposed that nature would have produced such immense masses of a matter proper for

organization, and then condemn it to the inertia, and, as it were, death of minerals.

Carbone and oxygen combine together and form a product that has not been hitherto noticed, and differing from the carbonic acid, or gaseous oxide, by sometimes admitting the presence of azote. Coals treated with nitric acid, increase in weight 20 per cent. This oxidized carbone being pulverized and heated in a small retort, underwent a strong detonation, but without emitting light, or causing any danger, and, at the same time, a great quantity of water came over, that carried with it some of the powdered charcoal. This great quantity of water seems to indicate that the oxygen of the nitric acid, and the hydrogen and carbone may form a kind of vegetable oxide, which is decomposed, by the temperature being raised, into water, carbonic acid, and gazeous oxide. Charcoal of fir, elm, and other wood, treated with nitric acid acquired an increase of 12 or 13 per cent.; and on being heated in a retort, it detonated, and yielded the above products without any nitrous gas. This is the oxide of charcoal mentioned in Proust's "memoir on Prussian blue." That formed from charcoal of fir was not altered in the course of several years; that from charcoal of the elm did not detonate so quickly as before.

Liquid potash, although boiling has no action upon coals, but if it be heated, even when diluted, upon oxidized coals or charcoal, it forms a coffee-colour solution which is not altered by standing, or the addition of water.

Ammonia acts equally upon both, 100 grains of oxidized coals from Villa Nueva were dissolved except 15 grains, either because they were not oxidized, or their oxygen had been transferred to the portion dissolved. This solution yielded with acids a brown precipitate, which became black and shining when dry, and did not melt, or emit any smell on hot coals. It was also precipitated by the oxygenized muriatic acid. Oxidized coals left on combustion gray and slightly ferruginous ashes containing silica, alumine, and a little oxide.

As the proportion of coak yielded by different coals varies, it is evident that they must contain different quantities of hydrogen; it even appears that in some, the carbone is so concentrated that they are totally deficient in hydrogen; yet azote remains even in these. A vein of this coal is found in the mountainous pass that separates the Asturias from Leon, which is there called blende. This burns without any smell, and contains 93 per cent. of carbone. It leaves 7 per cent. of whitish ashes. Now although this coal contained the least possible quantity of hydrogen, it yielded Prussian ley when heated with potash, so that the azote found in it shewed its origin from the organic matter which is decomposed and converted into coals.

It is said that trunks of trees have been found, part of which were converted into jet, and part still retained their ligneous nature. Jet is not uniform in its qualities; a specimen from Murcia

yielded 46 per cent. of charcoal, without even softening; another specimen melted like resin, and yielded 52 of charcoal. Irish cannel coal yielded 70 per cent. of coak, and 5 of light-gray ashes.

Jet appears to be allied to vegetables, for when heated with nitric acid at 20°, it effervesced violently, and there was formed a deep yellow soft concretion which was easily separated. This was washed with water, which it rendered yellow, but in which it did not dissolve; being dried, it was very bulky, bitter, and soluble in alkohol. It detonated, or rather went off like a squib by a moderate heat like oxidized charcoal, and without any danger even in a retort. It yielded water, a little oil, ammonia, carbonic acid gas, gaseous oxide, and 40 per cent. of a charcoal three times its own bulk. The residuary nitric solution is deep yellow, very bitter, and yields the oxalic and benzoic acids.

Mineral coals heated with nitric acid of 40° dissolve slowly, without leaving any charcoal, and yield the detonating substance, but in smaller quantity, and with greater difficulty than jet. Cannel coal for the most part agrees with coals in this respect, and so do some specimens of jet.

The primary action of the nitric acid being to displace the hydrogen, it is evident that hydrogen is not a necessary ingredient in this detonating substance. Oxidized Villa Nueva coals treated with nitric acid of 40° yields this substance, so that the azote and oxygen of the acid forms with the carbone of the coals a vegeto-animal compound, or artificial oxide.

Nitric acid of 35° or 40°, heated with charcoal of fir, or of elm, yields at first some gas, but afterwards this emission ceases, and the charcoal dissolves. The solution is permanent, and is not precipitated by alkalies.

Villa Nueva coal treated with concentrated sulphuric acid, and then washed and dried, acquires 4 per cent.; it burnt with a sulphureous smell, without any bituminous odour.

Turf from Dax left 40 per cent. of charcoal of its original bulk. It yielded water, acetic acid mixed with ammonia, and a yellow oily vapour, which concreted into a kind of tallow weighing about 6 or $6\frac{1}{2}$ per cent. of the original turf. The gases were not examined.

Turf is entirely soluble in potash forming a coffee-coloured solution, which is precipitated by acids in brown flakes, that become on drying black, shining, and brittle. By distillation they yield the butyraceous oil, and leave half their weight of charcoal, without being softened, or altered in bulk.

Nitric acid of 30° does not decompose turf as it does coals. The residuum washed and dried yields by distillation water, and no acid, but the butyraceous matter comes over, so that it seems to be contained ready formed in the turf.

Nitric acid of 40° boiled upon turf dissolves it, and forms oxalic acid, bitter yellow matter, and no detonating substance.

The incineration of turf is slow, its charcoal is red and does not

exhale the ammoniacal scent of azotized charcoals; its ashes are gray, they do not contain any saline matter, nor lime, they do not change the colour of the juice of the blue-bottle, nor effervesce with acids, they contain much silica, some sulphate of lime, and a little magnesia.

Observations.—The formation of coal from marine animal substances has been already held by Arduino; but it is difficult on this supposition to account for the absence of phosphorus and muriatic acid in them. The experiments of Mr. Hatchett on the formation of an artificial tanning substance may be truly said to turn the balance entirely in favour of their vegetable origin. These experiments have been given by us in our second volume, pages 92, 94, and 447, and shew the vast importance of cultivating chemistry in a synthetic manner.

On Ores, and particularly on those of Cobalt and Nickel.—*By Mr.* Proust.—*Journ. de Phys.* Nov. 1806.

The analysis of ores has already shewn us that the arsenical ores in which the metals are in their proper form, are solutions of various sulphurets (as those of silver, copper, iron, cobalt, nickel, &c.) in arsenic. This last metal dissolving the sulphurets in unlimited proportions, but not altering the proportion between the sulphur and metal; in the same manner as water dissolves salts in various proportions, without causing any variation in the elements of those salts; but with this difference, that the former combinations are solid masses.

Nature appears to have first formed metals, their oxides and their sulphurets, and then to have mixed these in all manner of ways, in order to multiply the beings of nature without creating too great a number of truly elementary combinations. So that we have sometimes a pure oxide, and at others find the same oxide serving as a dissolvent of others; and in like manner, the sulphurets are found sometimes pure, sometimes mixed together by twos, threes, &c. and sometimes serving as a dissolvent of small quantities of other sulphurets.

Daubuisson has observed, that Klaproth's analyses of gray copper ore afford an example of a combination in variable proportions; but the fact is, that gray copper ore is not a proper chemical combination. To this species of union it is essentially necessary that the proportion of the elements be constantly the same, as in the sulphurets of silver, of antimony, &c. of which the external appearance may vary, but not the proportion in which the elements are combined; whereas it is probable that the more compound minerals, such as the white gray, arsenical and antimonial ores of silver, copper, and cobalt, are so very variable in their composition that no two specimens of any of them are alike. In the same

manner the sulphuret of antimony may be dissolved in the oxide of antimony ad minimum, in a variety of proportions to form the liver, glass, or crocus of antimony, with all the intermediate variety, although both the sulphuret nor the oxide are formed of invariable proportions of their respective elements.

The following are a few examples of such indeterminate combinations as have been observed lately.

The sulphuret of iron is found combined with sulphuret of copper, forming yellow copper ore; but when the sulphuret of iron begins to oxidize the unaltered blue sulphuret of copper gives an iridescent appearance to the ore. By fusion with potash, the sulphuret of iron is reduced to its minimum of sulphur; it yields sulphureted hydrogen with dilute sulphuric acid, and the sulphuret of copper is left undissolved. It may also be separated by very dilute nitric acid.

This yellow copper ore is changed into gray ore by union with the sulphuret of antimony. Another gray ore contains the sulphuret of lead and pure arsenic, while others from America are rendered gray by the sulphuret of silver alone.

The argentiferous gray ores are mostly composed of the sulphuret of iron, holding the sulphurets of copper, silver and antimony; sometimes that of iron is wanting, and the sulphuret of antimony is the solvent. In some, arsenic is found, but whether it be combined with the sulphur is uncertain.

In some of these ores the sulphuret of copper predominates; these are more compact, less brittle, and have a bluish cast with less metallic lustre.

The *negrillo* of the Spanish Americans constantly contains these four sulphurets, but in many various proportions; and no arsenic has yet been discovered in it. In some the sulphuret of copper is much less in quantity than the sulphuret of iron, or of antimony.

Some varieties of *negrillo* contain also the sulphuret of lead. These may be analysed by treatment with nitric acid, which oxygenizes the metals and the sulphur. If the oxygenizement of the sulphur furnished a sufficient quantity of sulphuric acid, the solution does not contain any lead, as the sulphate of lead is precipitated along with the oxide of antimony. Carbonate of potash triturated along with the precipitate, changes the sulphate into carbonate of lead, which may then be separated by dilute nitric acid.

The *negrillos* are sometimes found with the metals reduced to oxides, except the silver which is still sulphureted. They are sometimes mixed with sulphuret of zinc; but this is a mere mechanical mixture, discernible by the eye.

At Cren, near Valentia, there is still found an ore containing the sulphurets of iron, copper, antimony, and quicksilver united together in lumps of a gray metallic appearance, with a reddish play of colours. Nitric acid oxidizes all the sulphurets except that of quicksilver, which remains with the oxide of antimony, from which it may be separated by muriatic acid. Many of these lumps

are decomposed, at least externally. Their solidity is diminished, and the cinnabar that is left colours the new mass, which contains the oxides of iron and of antimony ad maximum, and the carbonate of copper. The sulphuret of quicksilver is indeed seldom altered, and it is doubtful whether oxide of quicksilver has ever been found at Almaden. The mild muriate of quicksilver has been discovered there, in small quantities, in pearl-coloured crystals, scattered upon sandstone.

In the centre of some lumps of the Chili muriate of copper is found a nucleus containing the sulphurets of iron, copper, and antimony, which is probably the ore from whence the muriate was formed by decomposition.

Sulphuret of lead contains sulphuret of silver in many different proportions; to these are sometimes added the sulphuret of antimony. The sulphuret of cobalt is also sometimes added to the sulphurets of lead and of silver: when this ore is melted with potash and iron, the cobalt is found on the lead which contains the silver.

Some sulphurets of lead contain only sulphuret of antimony, in others the sulphuret of copper is also present. At Linares, in Andalusia, is found an ore containing the sulphurets of lead, silver and copper; in this ore the sulphuret of copper resists the decomposition that transforms the other sulphurets into carbonates.

There are very few galenas which do not contain a mechanical mixture of oxide or sulphate of lead, which might lead one to suppose that lead combined with different proportions of sulphur. Sulphuret of lead is also combined with the sulphurets of tellurium of uranium, &c.

Sulphuret of antimony contains many different proportions of sulphuret of silver, some of which are black, but their powder is still red.

Arsenic unites with the saturated sulphuret of iron, and thus forms arsenical pyrites, in which the sulphur is not combined with the arsenic.

Arsenic also is found containing the sulphurets of cobalt, nickel, copper and iron; some of these contain much less of the sulphuret of nickel than of sulphuret of cobalt, others the contrary. There are also some arsenical ores of nickel that contain sulphuret of silver.

When these arsenical ores are distilled, the greatest part of the arsenic is sublimed, the sulphurets are found in the residuum, combined with the remaining arsenic. If these residuums are mixed with sulphur, and heated, realgar sublimed, which shews that the arsenic was not previously combined with sulphur.

A gray cobalt ore from Styria yielded by sublimation, first arsenic, and at last a little realgar. This probably arose from the sulphuret of iron ad maximum, letting go some of its sulphur so as to form that ad minimum. The residuum contained arsenic, and the sulphurets of iron, copper, cobalt and nickel. The nickel was in greater quantity than the cobalt.

A red kupfernickel from Andreasberg, yielded only arsenic. The residuum contained more arsenic, with the sulphurets of iron, copper, nickel and cobalt.

Crystallised cobalt ore from Tunaberg yielded arsenic and realgar. It contained the sulphurets of iron, copper, and cobalt, but not that of nickel.

A reddish kupfernickel from Poplet, in Catalonia, contains sulphuretted arsenic, iron, copper, and nickel, but no cobalt.

The kupfernickel of the Sierra Vermeja is an alloy of arsenic and nickel, and does not contain any sulphur. It was mistaken for an ore of silver, although it does not contain any of that metal. If ever nickel should become of much use this will be the best ore from which to extract it.

The gray cobalt ore of Tobschau, in Upper Hungary, is mixed with a greenish oxide, which may be extracted by dilute sulphuric acid. The solution contained arsenite of nickel. The metallic part exhibits by treatment with nitric acid, sulphur, iron, nickel, and arsenic, but no cobalt; this part does not, however, afford arsenic by distillation, any more than many other highly arsenicated ores of nickel and cobalt, owing, perhaps, to the arsenic being alloyed with those metals.

A gray heavy ore of Cobalt, from Schureberg, yielded by sublimation a little arsenic, and some traces of realgar; the residuum distilled with sulphur yielded realgar in abundance. This residuum contained also iron, cobalt, and a little copper, all sulphuretted.

A gray, very compact ore, from Aryagon, did not yield arsenic by sublimation; but, on adding sulphur, it yielded realgar. This ore contains cobalt, iron, and copper, all sulphuretted; but no nickel.

A gray, very ponderous specimen from Saxony, yielded only a small portion of the arsenic it contained, together with a little realgar.

It is easy to recognise nickel, cobalt, iron, and copper, when united in a solution. Sulphuretted hydrogen precipitates copper and arsenic, but if the latter is reduced to an acid state, only the copper is thrown down. The solution being heated to reduce the oxide of iron to its maximum, is to be precipitated by potash, ammonia then takes the cobalt and nickel, but leaves the iron, and when this ammoniacal solution is concentrated, the nickel is separated.

Speiss, *i. e.* the regulus obtained in the manufacturing of smalt, contains arsenic, cobalt, nickel, bismuth, iron, copper, and sulphur. When dissolved in nitric acid it deposites arseniate of bismuth. It always contains more nickel than cobalt.

It is therefore evident that it is not sufficient for chemists to say that a mineral contains such ingredients in such proportions; but they ought also to investigate the binary combinations by whose admixture in different proportions the mineral is formed. This is

particularly necessary in regard to the stony minerals, which at present exhibit combinations of earths, &c. in great variety. In effect, to say that a mineral contains so much silver, copper, iron, &c. gives no other idea of its nature than to say a palace is composed of so many bricks, so much mortar, &c.

Observations.—Mr. Smithson, *alias* Macie, in his analysis of the various calamines, was the first that made any decisive observations on the subject of the present paper, which may be regarded as an extension of his ideas on the composition of ores to the metals mineralized by sulphur or arsenic.

We perfectly agree with Mr. Smithson and Prof. Proust, in the views that they entertain of the composition of minerals from binary, (and perhaps ternary) secondary principles; and we consider the analysis hitherto given of ores to be in fact only preliminary experiments, from which ingenious chemists, when they have positively determined the quantity of oxygen, sulphur, &c. which are taken up by metals, may form such conjectures respecting their composition as may enable them to devise appropriate methods to separate, without alteration, the several immediate principles of which they are composed.

As to the analyses of stones, they are still more imperfect, because as the combinations of the fixed alkalies, earths, and oxides require in general so great a degree of heat for their fusion, that are all almost always found confusedly mixed together, whatever may be the proportions employed, we have fewer data on which to ground our opinions, respecting the binary compounds of which they consist. And therefore the analyses of them afford much less information than those of ores; while neither of them can be esteemed of greater importance in the true theory of chemistry, or any further advance made in the practice, than the recapitulations of the products of the distillation of organic substances, as made by the pharmaceutical operators of the school of Quercetan and Lemeri.

At the same time we are far from coinciding with Mr. Smithson, as to the proportions of the immediate principles in the compound, and of the primary principles in the immediate principles, being always capable of being expressed by a vulgar fraction whose denominator seldom or never exceeds five; but rather agree with Proust, that, at least in the more compound minerals, one of them serves as a solvent which dissolves the others in an infinite number of proportions below the maximum, as in the case of salts dissolved in water. This view of the subject certainly increases the difficulty of ascertaining their composition, as it prevents the application of the correction proposed by Smithson, and thus reduces the means of the chemist to the successive application of different solvents, a method which affords very precarious results from the uncertainty respecting whether the results be educts or products. The examination of the refractive power being limited to transparent substances, does not seem capable of much application to the correction of the analysis of minerals.

Experiments on Maize. By Mr. Proust.—*Journ. de Phys.* December 1806.

Maize leaves on distillation 24 per cent. of charcoal. The water with which this charcoal is washed renders lime-water turbid and precipitates nitrate of lead.

Maize charcoal is burned with as great difficulty as any animal charcoal, and leaves only a small quantity of tasteless ashes, which lost scarcely any thing by washing.

Ten gros (720 grains) of maize charcoal calcined for two hours, were reduced to 7 gros, these 7 calcined for 2 $\frac{1}{2}$ hours, were reduced to 5; these 5 calcined for 3 hours were reduced to 2 gros, 30 grains; it was still black, pasty, and stuck to the iron rod. On being washed it was reduced to 2 gros 8 grains, and these being calcined for an hour were reduced to only 60 grains.

The leys added together yielded 18 grains of a saline extract whose flavour was not sensibly alkaline. On being redissolved, it would not crystallize, but was reduced by evaporation to 14 grains of a dry mass, which was dissolved in distilled vinegar, and then treated with alkohol. By this means there was obtained 11 grains of acidulous phosphate of potash in tetraedral prisms terminated by similar pyramids.

100 gros of maize yield therefore only 34 or 35 grains of this phosphate, whereas it is stated by Saussure in the Journ. de Physique, that maize yields 40 per cent. of phosphate.

The charcoal of maize stalks when mixed with $\frac{5}{6}$ of saltpetre in a tube, is burned in nearly half the time as the charcoal of the seeds of maize.

Observations.—These experiments seem to have been instituted in order to examine the above-mentioned assertion of Saussure, respecting the quantity of phosphate of potash found in maize; but it is evident that it was one of those errors of the press, that disgrace the Journal de Physique, which may be justly affirmed to be one of the most carelessly edited works that issues from the French press.

Observations on Cast Iron. By Mr. Proust.—*Journ. De Phys.* December 1806.

Gray and black cast-iron yield an aromatic hydrogen, which seems to contain a portion of the oil that is formed during their solution in acids.

This hydrogen burns slowly with a yellowish and green flame, it consumes only half its bulk of oxygen, the same as if pure; neither does the residuum precipitate lime-water, but it must be

recollected that a small quantity of carbonate of lime is soluble in lime-water. Six cubic inches of this gas mixed with 16 ofoxygenized muriatic acid gas, were reduced in an hour to half a cubic inch, which was principally the acid gas. A cloud was formed when the gases were mixed, and an oily film floated on the water. Vauquelin has found phosphorus in this gas, and, indeed, all Spanish cast-iron contains phosphate, and most kinds of charcoal, (used in smelting the ores) as that of green oak contain either a phosphuret or a phosphate, as this last is found in their ashes.

The charcoal which is separated from cast iron, has the scaley leaden appearance and lustre of plumbago, particularly when it is well cleared of iron by the muriatic acid. It will still admit of some doubt, whether plumbago is a carburet of iron, as is commonly believed.

Iron refined according to the method of Mr. Grignon, by a prolonged effusion had not the granular aspect of gray cast-iron, but seems to consist of a heap of small needle-like cones, very obtuse, between which there lay scales of plumbago. It was easily cut by the file, but crumbled under the mill-hammer, nevertheless an expert workman succeeded in forging a plate from it, which when tempered, was found to be sufficiently tough. Therefore although cast-iron becomes more metallic by a longer exposure to heat, it loses the oxide that produces the solidity of the mass, and acquires in its room charcoal, which forms a compound by no means so tenacious as the other.

If the existence of carburet of iron is taken for granted, its presence in cast-iron yields an example of a body united to an excess of one of its elements.

Cast iron smelted with pit-coal in low furnaces, whose power is not sufficiently great to smelt the ore perfectly, boiled from the time it was let out of the furnace, until it congealed. It yielded only a spongy white iron, not fit for bullets, and which afforded much less hydrogen than the common white cast iron. This ebullition was only the continuation of the effervescence that was left unfinished by reason of the iron not remaining long enough in the furnace.

The labours of Bergman, Berthollet, and other chemists, added to the methods adopted by the iron masters in England, all shew that cast iron is only a solution of oxide of iron in its own metal. This species of union is rather doubted by Berthollet, and yet there are numerous examples of it. Black copper contains sulphuret of copper, and also sulphuret of iron, and sulphuret of silver. Chenevix has found oxide of copper in copper, and Fernandez, muriat of silver in silver; so phosphorus sometimes holds phosphuret of carbone. Amalgams are similar combinations, some separate from the excess of quicksilver, other remain in solution. Water, again, is soluble both in oxygen and hydrogen, which are its elements. When the vapours of oils, &c. are driven through a heated tube, the hydrogen takes up some of the unde-

composed vapour. The solution of sulphur, phosphorus, carbone, arsenic, zinc, &c. in hydrogen, appears to be in fact a solution of the hydrogurets of those substances in an excess of hydrogen. The old books on chemistry exhibit numerous instances of these combinations, but Berthollet ought not to find fault with Mr. P. for not giving the characters of these combinations, for they have not yet been duly examined, although the general circumstance of their being solutions of a compound in an excess of one of its principles is ascertained.

There has been found in the rocks of Artamar in Valentia, a fine specimen of yellow ochre. It contains a little carbonate of lead, which may be separated by dilute nitric acid, without altering its colour. By distillation it yielded a little carbonic acid, 12 per cent. of water, and 88 per cent. of a red powder, from which muriatic acid separated 4·1 of sand Hence it was a hydrate of the red oxide of iron, containing 27 of water to 100 of oxide.

It is probable that a hydrate of the black oxide may be hereafter found; especially as it seems to enter into the composition of the carbonate of iron.

On the Separation of Sulphur from Metals. By Mr. Guèniveau. —*Journ. des Mines*, No 121.

Some natural metallic sulphurets, afford by their decomposition very useful substances, as those of iron, copper, lead, quicksilver. The properties of these compounds are well known to chemists; but these facts have not as yet been compared with those known in the smelting-houses.

The action of heat is common to all these operations, and ought therefore to be first examined: it has been supposed to be very powerful in separating sulphur from metals, but this opinion appears to be unfounded.

The sulphurets of arsenic and of quicksilver are volatilized by heat; the appearance of the sublimed sulphuret is frequently different from that which has not been sublimed, and Proust and Thenard have shewn that this is owing to the different proportion of sulphur.

Iron pyrites yield by distillation only half of the sulphur they contain. In the Saxon smelting-houses, these pyrites yield only 13 and 14 per cent. of sulphur. Pulverized iron pyrites put into a lined crucible, covered with powder of charcoal, and exposed to the heat of a forge, was completely melted, but only one-third of the sulphur it contained was separated from it.

Copper pyrites yield only a little sulphur by distillation. This ore as well as vitreous copper ore, are probably only mixtures of the sulphurets of copper and of iron, and the sulphur is yielded only by the latter.

Galena on distillation yielded at first a little sulphurous acid,

owing to the air contained in the apparatus, and then a very small quantity of sulphur was sublimed. The residuum preserved its metallic brilliancy, but did not contain any metallic lead. Pulverized galena, put into a lined crucible, covered with powder of charcoal, and exposed to the heat of a forge, was melted into a matt, some part of it was rather ductile. The galena had lost 27 per cent. of its weight, but on being analysed, it appeared to have lost only two-fifths of its sulphur, the remaining loss being due to the volatilization of the galena itself.

Most authors have supposed heat to be only agent in the operation of roasting ores; yet it has always been acknowledged to be necessary to prevent the fusion of the ore. But the oxygen combining with the elements of the sulphurets, forms oxides and acids whose elective attractions contribute to the separation of the sulphur.

Copper pyrites being spread upon faggots and roasted, at first exude some of the sulphur, which may be collected; another part of the sulphur serves to keep up the combustion, and produces sulphurous acid gas which flies off; the sulphuric acid that is formed at the same time combines with the oxides of iron and of copper, but the sulphate of iron is partially decomposed by the hyperoxygenizement of the metal.

Iron pyrites yield, by the same operation, similar results.

Copper pyrites roasted in a reverbatory furnace, produce the same phenomena. It ought to produce a more compleat separation of the sulphur than the roasting in the open air; but the fusion of the pyrites is difficult to be prevented. In Sweden they roast and smelt copper pyrites in one operation, the furnace has in the inside a bason in which the sulphur contained in the melted mass is separated, or rather burned, by the blast from the bellows being blown with such force as to drive away the scoriæ, and permit the air to burn the sulphur, and form an oxide with the iron, which oxide is vitrified by an addition of quartz.

Galena is very difficult to roast in small quantities, the produce is always a mixture of oxide of lead and sulphate of lead. The schlich of Pezey, which has been roasted in the open air, contains from $\frac{1}{3}$ to $\frac{1}{2}$ of sulphate of lead; from whence it appears that only half the sulphur in the galena is separated by this kind of roasting. In the reverberatory furnace the separation is carried so far that the mere addition of charcoal is all that is necessary to cause the ore to yield a great proportion of lead. That sulphate of lead is formed in these furnaces, is evident from its being sublimed into their chimneys; but the undecomposed galena appears to act upon this sulphate. In effect, one part of sulphuret of lead being heated with three of sulphate of lead, yielded sulphurous acid gas, but no sulphuric acid; the residuum was a mixture of oxide with sulphate of lead, so that the sulphuric acid was decomposed by the sulphur and lead, while another part of

the sulphurous acid proceeds from the sulphur of the galena. Equal parts of galena and sulphate of lead left a mixed residuum of oxide and sulphuret of lead : 14 of sulphate of lead with 8 of galena melted in a crucible, yielded a regulus of lead, and glass of lead, without any signs of sulphate.

From these experiments, the theory of roasting galena in reverberatory furnaces is evident. The heat separates part of the sulphur, the air converts another part into sulphurous acid which escapes, and another into sulphuric acid, which forms sulphate of lead. When the ore is stirred, the sulphate is mixed with the undecomposed sulphuret, and thus is decomposed. The repetition of these operations, if the process is well conducted, produces a nearly pure oxide of lead. If any sulphate is left undecomposed, it is reduced during smelting by the charcoal into sulphuret. The roasting therefore, of galena is in fact the conversion of the sulphur into sulphurous acid, and the formation of sulphate of lead, renders this conversion easy to be effected.

The decomposition of galena in those blast furnaces in which it is roasted and smelted in a single operation, appears to be of a similar kind. The decomposition is less complete in the higher furnaces than in lower ones : as the former always produce matts, even from ores that are completely decomposed in low blast furnaces. The air that has passed through the high furnaces being deprived of its oxygen, cannot form sulphurous acid ; but that which passes through the low furnaces not being deprived of oxygen, is capable of giving that principle to the sulphuret. If any of the sulphuret passes through the furnace undecomposed, it is returned and submitted to a fresh action of the oxygen.

Sulphur may also be separated from the metals by substances that possess a stronger elective attraction for it ; provided that the compounds thus formed have such properties as enables them to separate from the pure metal. Lime and iron are usually employed.

The sulphuret of quicksilver is easily decomposed in this manner, by reason of the volatility of the quicksilver.

Copper pyrites is smelted in some places along with lime, but the theory of this operation has not been properly examined: 10 grammes of copper pyrites heated with 4.3 gr. of iron-filings, yielded a homogeneous mass, without the least trace of metallic copper being separated. 10 gr. of copper pyrites, heated with 5 gr. of the same ore roasted, also yielded a homogeneous mass. An equal quantity of crude and roasted copper pyrites, imbibed with olive oil, and exposed to heat in a lined crucible, was not melted. The separation of sulphur from copper by means of iron, is therefore very difficult, because they form either a triple compound, or a combination of the two sulphurets of copper and iron.

Galena is easily decomposed by this kind of treatment. Lime is seldom employed. The use of iron is very common ; when the iron is in too small proportion three distinct substances are ob-

tained, viz. lead, sulphuret of lead, and sulphuret of iron. A number of experiments have been made at the Ecole des Mines at Mont Blanc, on the decomposition of galena by iron, which it is to be hoped will be published.

On the Smelting of Lead ore with a mixture of Charcoal and Fossil Coal. By Mr. Schrieber.—*Journ. des Mines*, No. 121.

The fossil-coal used in this experiment, when mixed with wood or charcoal, burned without any flame, and was very slowly consumed. It became covered with reddish yellow-ashes, that prevented the complete combustion of it. The cinders were nearly equal in bulk to the original coals, and weighed 19 per cent. of their weight. It is the best that is to be found in the neighbourhood of Pesey.

On using a mixture of this coal with charcoal in smelting lead ore in a low blast furnace, the operation was performed with difficulty on account of its stopping up to the twyer. 41cwt. 70lb. of roasted ore required for its fusion 10cwt 80lb. of charcoal, and 10cwt. 10lb. of fossil coals. It yielded 9cwt. 94lb. of scoriæ, containing as by an essay made of them, 35lb. of lead, and 33409 milligrammes (506 gr.) of silver per cwt: 22cwt. 33lb. of lead, including that in the scoriæ; and 2937491 milligrammes (6¼lb. Avoirdupoise) of silver, including that in the scoriæ.

A smelting of 41cwt. 70lb. of roasted ore with charcoal only, consumed 15cwt. of that fuel; and produced 7cwt. 85lb. of scoriæ, containing, as by an essay made of them, 32 or 33lb. of lead, and 28522 milligr. (440 grains,) of silver per cwt. 24cwt. 21lb. of lead, including that in the scoriæ, and 2958959 milligr. (6½lb. Avoirdupoise) of silver, including that in the scoriæ.

The smelting therefore of lead ore in a low blast furnace, with coals of the above quality, cannot be recommended, unless where charcoal is scarce. As they burn without flame, they would be entirely useless in reverberatory furnaces.

Observations.—The coals used in these trials were evidently of so bad a quality, that no success could be expected, nor would any person acquainted with the use of coals ever have thought of making the attempt.

On Yenite, a New Mineral. By Mr. Lelievre.—*Journ. des Mines*, No. 121.

The specific gravity of yenite, is about 4, viz 3.825, 3.974, 3.985, 4.061. It is scratched by adularia, but it scratches glass, and strikes fire with steel. It is opake, and of a black colour, drawing sometimes towards brown, and its powder is of the same colour. The surface of the fine black crystals is brilliant.

The lateral faces of the prisms are streaked lengthways. Some particular faces of the summits are smooth and very brilliant. Its grain is unequal, and it is of a greasy appearance, like phosphate of manganese. It is not electric by heat or friction. It becomes attractible by the magnet, by being ignited, becomes dark reddish brown, and loses about 2 per cent. of its weight. It weathers in the air, and becomes covered with a yellow or brown earthy crust, resembling iron-ochre.

Mr. Cordier has calculated the primitive form, and examined its various secondary forms. On cleaving yenite it shews appearances of plates parallel to the sides of a prism with a rhombic base, whose angles are 112° 37′ 9″ and 67° 22′ 51″. Some slight appearance of a division according to the small diagonal of the rhombs, is shewn by streaks on the surfaces of the summit. The bases exhibit no cleavage, but their fracture is conchoidal, unequal, &c. Its primitive form is a straight prism with a rhombic base, whose diagonals are to each other as 2 to 3. Its height is to the small diagonal as 4 to $\sqrt{7}$.

There are five varieties of form.

1°. The primitive form lengthened and terminated by a tetraedral pyramid, whose faces are placed on the terminal edges.

2°. A tetraedral prism, nearly rectangular, terminated by a low diedral summit placed on the obtuse angles.

3°. The preceding form with a double truncature on each sharp angle of the diedral summit.

4°. An eight-sided prism, terminated by a low summit of eight faces, of which 4 are placed on the terminal edges of the prism, and 4 on the angles.

5°. The preceding form, with another face on the summit parallel to the base of the primitive form.

The varieties 2 and 3 are commonly brownish, and have a dull surface.

The forms resemble those of epidote (actynolete, or strahlstein) but the angles are different.

It melts very easily by the blowpipe, without any sensible boiling, and it yields an opake, dull, black bead, very attractive, but without any polarity, and having a metallic appearance. It is soluble in borax with a slight effervescence, the fusion being continued it yields a black enamel; if more borax is added, it yields a transparent yellowish green glass.

It is is soluble in sulphuric, nitric, and still more easily in muriatic acid; the solution is of a fine yellow, with a greenish tint, a residuum of silica is left.

It was analysed by Mess. Vauquelin, and Descotils, unknown to each other, and yielded as follows.

Mr. D. 28 per cent. of silica, 12 of lime, 55 of oxide of iron, 3 of oxide of manganese, and 0.6 of alumine, 1,4 being lost.

Mr. V. in one analysis 29 per cent. of silica, 12 of lime, and 57 of the oxides of iron and manganese, 2 being lost: in another, 30 of silica, 12.5 of lime, and 57.5 of the oxides.

It was found in two places on the island of Elba, viz. at Rio la Marine, and at Cape Calamita.

The Rio la Marine yenite, forms a part of a very thick bed laying upon primitive lime-stone mixed with talc. It is disseminated in an unknown green substance, which is very analogous to the yenite itself. The yenite is found in masses which are sometimes several decimetres cubic, and frequently line the fissures of the rock. It is commonly composed of distinct concretions, each of which is formed of rays divergent from a centre. Sometimes the rays are nearly parallel, and so connected together that they form compact masses splitting into irregular prisms. At other places, the rays, particularly when their extremity is free, terminate in true crystals. It is also frequently found in long pieces, or irregular prisms the size of a finger, or even much smaller, in the middle of the green substance, from which, however, it is distinctly parted. It is sometimes found in the cavities of that substance, in crystals pointed at each end, 3 or 4 centimetres ($1\frac{1}{4}$ or $1\frac{1}{2}$ inch) long, either insulated, or in groups. The same bed contains fine yellowish green epidote, quartz, arsenical iron, amorphous oxydul of iron, or loadstone. Some crystals, which appear to have come from this place, have been found in the collection that formerly belonged to Romé Delisle, placed at the end of the tin ores.

The yenite of Cape Calamita is found in the same substance, which, however, is here of a grayer cast, and has the appearance of some asbestiform actinotes. It is accompanied with oxidule of iron, garnets and hyaline quartz. Mr. Fleurian de Bellevue brought some specimens from this Cape to Paris, nine years ago, which being the next year analysed by Mr. Vauquelin, yielded 30 per cent. of silica, 14.8 of lime, 49 of oxide of iron, 2 of oxide of manganese, and 1 of magnesia, 3.2 being lost.

A specimen of black yenite disseminated in the same kind of greenish substance, is said to have been found in Siberia, between Perm and Tobolsk.

This mineral might be used as an iron ore, if it were not found close to the richest iron-ores in the world.

The green substance that always accompanies yenite differs only from it, by the quantity of iron that it contains; having in other respects the same physical and chemical characters, so that it appears to be of the same species.

Observations.—This mineral, from the quantity of iron that it contains, seems to be best arranged among iron ores; although from the quantity of earths that it contains, it is probable that many mineralists will arrange it among the siliceous earths.

On the Polierschiefer, from Billin, in Bohemia.—Journ. des Mines, No. 121.

POLIERSCHIEFER is found near Billin, in Bohemia, immediately under the vegetable mould. It is yellowish white, of a slaty tex-

ture, and of an earthy aspect, leaving a mark upon cloth. It is easily reduced, by the fingers, into a powder that is rather rough to the touch. It sticks strongly to the tongue, and is unfusible. Its specific gravity is 0.6, according to Heberlé. One hundred parts of it absorb 17 of water. It is sold in Saxony by the name of *silber-trippel*. It increases its density, as it lays deeper in the bed, so that at two metres (yards) deep, it is compact, and glimmering like some semiopals. The bed contains the remains of vegetables, and impressions of fishes.

Bucholz found it to contain 79 per cent. of silica, 4 of oxide of iron, 1 of alumine, 1 of lime, and 14 of water; 1 being lost. He also found the *klebschiefer*, in which menilite is found, to contain 58 per cent. of silica, 6.5 of magnesia, 9 of the oxides of iron and of manganese, 5 of alumine, 1.5 of lime, and 19 of water; 1 being here also lost.

Observations.—Lampadius's Analysis of klebschiefer is quoted at p. 33, aad Klaproth's at p. 172, and 312 of our present volume. The present analysis, by Bucholz, resembles that by Klaproth; but we still retain our opinion, that klebschiefer is only an aggregate, mechanically formed of different species of earth.

Analysis of some metallic Sulphurets. By Mr. Gueniveau.—*Journ. des Mines,* No. 122.

Proust has shewn that iron, copper, and lead combine with certain limited proportions of sulphur; but his opinions are supported only by synthetical experiments. Hatchett has also estimated the quantity of sulphur in magnetic and other pyrites, by means of sulphate of barytes; but both these methods are liable to some uncertainty.

Bronze yellow pyrites was examined for iron, first by boiling it in mixture of nitric and muriatic acids, precipitating the iron by ammonia, and igniting the precipitate; 2° by roasting another portion, which left the same proportion of oxide; 3° by smelting the roasted pyrites in a lined crucible, and allowing 3 per cent. for the quantity of charcoal absorbed by the iron. All these methods agreed in shewing the iron to be 45 per cent. of the whole pyrites.

It was also examined for sulphur, by pouring a solution of muriate of barytes into the nitromuriatic solution, and estimating the sulphate of barytes that fell down to contain 14 per cent. of sulphur, following Klaproth, rather than Chenevix or Hatchett; and also by treating pyrites with dilute nitric acid with a very slight heat, and then precipitating the solution with muriate of barytes. By these methods pyrites was found to contain 55 of sulphur.

Sulphuretted copper of Siberia was also examined. Its specific gravity was 5.22; and it contained 74.5 per cent. of metallic copper, 20.5 of sulphur, and 1.5 of oxide of iron; 3.5 being lost, part of which was probably copper. On heating this sulphuret in a lined crucible, it melted, and lost $2\frac{1}{2}$ per cent. of its weight; but its appearance was not changed, and only a few globules of copper was found in the lowest part of the mass.

Another specimen of the same ore, although very homogeneous in appearance contained much quartz, for it yielded sparks when struck against steel, and contained 47 per cent. of copper, 13 of sulphur, 25 of a siliceous residuum, 7 of lime, and 9.3 of red oxide of iron, so that there was an addition of 1.3 per cent. The proportion of sulphur to the copper was the same as before, and therefore the iron appears to be combined with the silica and lime to form the matrix.

Copper pyrites from Sainbel, without any heterogeneous admixture, whose colour was greenish bronze yellow, and of the specific gravity of 4.16 was analysed, it was found to contain, on a medium of two experiments, 36 of sulphur, 30 of copper, 32 of metallic iron, 1 of oxide of zinc, and 1 of quartzose matrix.

Another specimen from Baigorry, mixed with quartz, was found, on a mean of two analyses, to contain 31.5 per cent. of sulphur, 27.5 of copper, 29.5 of metallic iron, and 9 of quartzose matrix; 2.5 being lost. Indeed, the proportion of sulphur is always stated too small in these analyses, as some of the sulphuric acid formed is constantly evaporated.

Proust has shewn that copper pyrites contains sulphuret of copper, and considers the pyrites as a mixture of the two sulphurets of copper and iron. Chenevix obtained from copper pyrites 30 per cent. of copper, and 53 of oxide of iron, equal to 35 of metallic iron. A yellow copper ore from Chessy was also found to contain 30 per cent. of copper, so that it appears probable that copper pyrites is a true mineral species.

On a Mineral supposed to be pure native Magnesia.—Journ. des Mines, No. 121.

There is sold at Paris, by the name of native magnesia from Moravia, a mineral in amorphous lumps, the size of a man's thumb, covered with a yellowish white earthy crust, which slightly sticks to the tongue, and is rather greasy to the touch. Its fracture is dull, quite compact, imperfectly conchoidal, approaching to flat. It is yellowish white, and filled with small cavities, whose internal surface is covered with small risings, which appear, on being exposed to a strong light, to be covered with crystalline points. It is rather hard, approaching to hard; it scratches glass; but steel leaves on it a trace of its own colour. It does not strike

fire with steel. It is very translucent on the edges; its specific gravity is 2.83. It does not absorb water, or stick to the tongue.

By the blowpipe it splits but does not melt. It is not phosphorescent. It is soluble with effervescence in nitric or muriatic acid; the sulphuric acid throws down a precipitate.

It differs of course, from the native magnesia of Werner.

Bucholz found it to contain 28 per cent. of lime, 20.5 of magnesia, 1.5 of manganese with a little iron, and 48 of carbonic acid, 2 being lost. It is therefore a variety of *bitterspath.*

Observations on Muriatic Ether. By Mr. THENARD.—*Journ. de Phys. March* 1807.

MURIATIC ether is most commonly produced in a gaseous form. Equal quantities of concentrated muriatic acid and of alkohol at 36° are poured into a retort just big enough to hold the mixture, and a small quantity of sand added. A tube connects the retort with a three-necked bottle, twice as big as the retort, into the second neck is inserted a safety tube, and into the third a bent tube which communicates to a small earthern cistern, in which air jars are inverted in water. The three-necked bottle is half full of water at 20 or 25°, into which the tube from the retort is sunk 7 or 8 centimetres (3 inches) deep.

This apparatus is placed on a wire frame on a common open stove, and fire is to be very cautiously administered, as the whole difficulty of the process rests on this point. By this means there may be obtained from 500 grammes (1 lb.) of muriatic acid and an equal measure of alkohol, from 20 to 30 litres (40 to 60 pints) of pure ethereal gas. More gas may even be obtained by adding fresh alkohol to the acid residuum, and perhaps it would be still more advantageous to have a tube inserted into the neck of the retort so that warm alkohol might be added during the distillation. It is also proper always to use the same water to collect the gas, and to employ only the smallest possible quantity.

The ethereal gas is absolutely colourless, it has a strong ethereal scent and a sweet taste. It has no action whatsoever on tincture of litmus, syrup of violets, or lime-water. Its specific gravity to air at 18° Cels. and at 0.75 metre of pressure, is as 2.219 to 1. Water dissolves an equal bulk at the above temperature and pressure; but this is entirely separated by a boiling heat. At the same pressure, but at the temperature of + 11° Cels. this gas becomes liquid.

The ethereal product may be obtained at once in a liquid form by receiving it in eudiometer tubes surrounded with ice. The liquid ether is extremely limpid, and has no action upon tincture of litmus or syrup of violets. It is like the gas, very soluble in alkohol, from which it may for the most part be separated by

water. It has a very strong smell like that of the gas, and the same saccharine taste, particularly when water is saturated with it. Being poured on the hand it suddenly boils, produces a considerable coldness, and leaves a small whitish spot. At + 5° Cels. its specific gravity is 0,874, so that notwithstanding its volatility, it is heavier than alkohol. It does not freeze even by a temperature of — 29° Cels.

But the most singular property of this substance is, that although whether it be in the state of gas, or condensed into a liquid, or absorbed by water, it does not redden the most diluted tincture of litmus, nor is it acted upon by the strongest alkalies, nor does it render nitrate of silver turbid, it is no sooner burned than so great a quantity of muriatic acid is developed, that it precipitates the concentrated solution of nitrate of silver in a mass. The acid is even rendered sensible by its vapours and suffocating odour.

To endeavour to discover whether this quantity of acid was educed or produced from the gas, 451 grammes (14 oz.) of acid of the specific gravity of 1:1349 at 50° Cels. were employed, which with an equal measure of alkohol yielded 23 litres (quarts) of gas, at the expense of 122 grammes ($3\frac{3}{4}$ oz.) of acid. This acid might be contained in the gas, either in the form of muriatic acid, or its elements might form a triple or quadruple compound with the elements of the alkohol, or only one of its elements might be contained in the gas. In the latter case, the gas on being decomposed by passing through an ignited tube without admixture of air, would not yield acid. But on distilling 900 grammes (28 oz.) of muriatic acid with alkohol, and passing the 50 litres (quarts) of gas produced from it through an ignited glass tube, nearly the whole of the 250 grammes (8 oz.) of acid, which had disappeared, was collected, a loss only of 4 gr. (60 grains) being sustained.

It is plain, therefore, that the whole substance of the muriatic acid is present in the gas. If the acid is supposed to be a simple element, great difficulties occur, since the strongest alkalies do not separate it from the other constituent principles, and although the gas contains a greater proportion of acid than is contained in muriate of potash, it does not affect nitrate of silver. We are, therefore necessitated to suppose that muriatic acid is a compound body, whose elements exist in the gas combined with the elements of the alkohol.

Observations.—These experiments, in consequence of the views they open respecting the nature of muriatic acid, have made a great stir among the chemists of the Institute, who have thought it worth their while to examine whether similar facts were known to other nations. They acknowledge that Gehlen had previously discovered muriatic ether and observed its singular properties, but his experiments were made on ether less pure, its specific

gravity being only 0.845, this ether was prepared from concentrated sulphuric acid, alkohol, and melted sea-salt.

The ether thus obtained, is certainly a very singular product, and merits the utmost attention.

On an Economical Substitute for Quick-match in the Artillery Service. By Mr. PROUST.—*Journ. de Phys. March* 1807.

THE Spanish ambassador at Vienna, in 1789, gave notice to his Court, that the use of thin rods of lime tree soaked in a solution of nitrate of lead, was adopted in the Imperial service in lieu of quick-match. Mr. P. has forgot whether the author of this discovery was named, but it was probably Baron Born.

As the lime or linden tree is scarce in Spain, other woods were tried. The principal fault of these wooden rods is the brittleness of their point, but this does not entirely extinguish them, for it is sufficient to twirl them about a little to relight them.

A pound of nitric acid at 36°, yields, with lead, upwards of 15 oz. of dry nitrate; but as a great part of the acid is wasted in oxydizing the metal, if this was employed in the state of oxide, more might be obtained, thus, a pound of the same acid treated with litharge yielded nearly 23 oz. of nitrate. The loss of acid in the former process was very great, for a pound of nitric acid at 25° yields, with potash, 8 oz. of saltpetre, but if another pound be treated with metallic lead, and the nitrate decomposed by potash, only 3 oz. of saltpetre is obtainable.

The rods must not be too thick, or otherwise the nitrate does not penetrate to the centre; the best thickness is about 2 or $2\frac{1}{2}$ lines ($\frac{1}{6}$ or $\frac{1}{5}$ inch) but in order to encrease their strength they may be made broader one way than the other. Yet thick rods have some advantages, for the unimpregnated centre burning slower than the superficial parts, gives a solidity to the lighted point, and renders it less liable to break off.

Rods of willow or elm will not burn unless they are impregnated throughout, and those of ash and beech which are more than a line ($\frac{1}{12}$ inch) thick, do not absorb sufficient nitrate to burn without being liable to go out.

The solution may be made of two different strengths, that of one pound of nitrate in 4 of water is best for green oak, elm and willow; and that of one pound of nitrate in 5 of water for lime-wood, oak, fir, walnut, white poplar and cedar. The impregnation may be performed in 3 days in the cold, or in one hour and a half, if the solution is boiled.

Rope made of broom-stalks, about $\frac{3}{4}$ in. thick, may be advantageously impregnated with a solution of one pound of nitrate in 15 of water. This is superior to the others, because it will burst into a flame if it be twirled round, and so perform the office of a

port-fire. It might probably be still more useful if it was spun with a better prepared strand in the centre, or with the *pittle* (rush ?) so common in the interior of Spain.

The following are the results of the experiments made with nitrate of lead.

Woods, &c.	Duration of the combustion of 25lb.	Nitrate absorbed by an Cwt.
	Hours.	lb.
Quickmatch	850	
Broom rope, prepared	850	4
Lime	2400	10
Fir	2400	42
Cedar	2400	42
Elm	2430	19
Oak	2200	18
Green oak	1400	18
Walnut	1400	7
White poplar	1400	37
Willow	2400	30

Hence it is evident that the lime is the best, that the oaks, elm, and walnut are next best, and that poplar, fir, cedar and willow absorb a great quantity of nitrate without any advantage.

The nitrate of copper may be used instead of the nitrate of lead, and its power of encreasing the combustion is such, that, the rods taken fresh out of the solution burn equally well as those impregnated with nitrate of lead do when dried. It is not so much the acid of these salts that produce the effects as might be supposed, for if they are soaked for some time in water, they still preserve much of their peculiar qualities. It rather appears that the oxides of these nitrates separate from the acid and attach themselves to the substance of wood, and then furnish the oxygen necessary to the combustion of the rods; agreeable to this opinion, the lead is reduced in grains, and the copper coats the point with a thin sheath of metal which it is sometimes necessary to get rid of, by striking the point against the cannon.

One pound of nitric acid at 36° is saturated by $2\frac{1}{2}$ oz. of copper. The solution used to impregnate the rods exhibited 17° of Beaume's hydrometer. The solution of copper procured in the process of parting by the refiners may be employed; and if a proper proportion of lead is boiled in it, this solution may be changed into nitrate of lead, but if too much lead is added, a yellow lamellar nitrate is formed, whose effects on wood is unknown.

Walnut wood does not absorb sufficient nitrate of copper to form fire-sticks.

Nitrate of iron is unfit for this purpose, as it does not yield its oxygen, so easily as that of lead or copper.

The following are the results of the experiments with nitrate of copper.

Woods, &c.	Duration of the combustion of 25lb.	Nitrate absorbed by an Cwt.
		lb.
Quickmatch	850	
Lime	2500	6
Fir	2300	8
Elm	2100	7
Oak	2400	4
Green oak	2050	9
White poplar	2010	6
Willow	2130	9
Ash	1300	2

Observations.—In our present volume, p. **165**, we gave an abstract of a paper on this subject, by **Mr. Cadet.** We have not the least doubt of the great superiority of these impregnated rods over the common match.

On the Composition of Alkohol and sulphuric Ether. By Mr. THEODORE SAUSSURE.—*Journ. de Phys.* April 1807.

THE method adopted to ascertain the composition of alkohol and sulphuric ether, was to change them by the addition of oxygen into water, and carbonic acid gas; and thus to investigate the quantity of carbone, oxygen, and hydrogen, that they contained.

But as the proportion of the principles of water and carbonic acid gas are not yet positively fixed, it is necessary to state those here assumed, which were, that water contains 88 per cent. in weight of oxygen, and 12 of hydrogen; that hydrogen takes up half its volume of oxygen in forming water; that 1000 cub. in. of perfectly dry hydrogen at 28 in. pressure, and 10° Reaum. weigh 34,303 grains; that 1000 cub. in. of oxygen, saturated with moisture at the same pressure and temperature, weigh 512,37 grains; that 1000 cub. in. of carbonic acid gas in the same circumstances, weigh 693,71 grains; that carbonic acid gas requires for its formation an equal bulk of oxygen; and that carbonic acid gas saturated with moisture contains 26 per cent. in weight of carbone.

The alkohol analysed had been twice distilled over perfectly dry muriate of lime; and its specific gravity was 0,792 at 16° Reaum.

35½ grains of alkohol were burned in a lamp formed of a narrow graduated tube, that shewed by inspection the quantity consumed. This lamp was placed under a jar standing over water, that was originally half full of air, and to which some oxygen was added. The jar then contained at 27 in. pressure, and 17° Reaum. 228¼

cub. of oxygen, and 422¾ of azote, in all 651 cubic inches. There remained after the combustion, when the air was reduced to the same temperature, 599 cubic inches, of which 77,87 was carbonic acid gas, 98,42 oxygen, and 422,71 azote. The small absorption of carbonic acid gas that could possibly take place by the water in which the jar is placed, was amply compensated by the same water absorbing the alkoholic vapour that was so troublesome in Lavoisier's experiment.

From this experiment, the constituents of alkohol may be stated at 53,745 per cent. of water, 36,89 of carbone, and 9,365 of hydrogen; or, substituting the elements of water for water, then it will contain 47,296 per cent. of oxygen, 36,89 of carbone, and 15,814 of hydrogen. To these must be added a small quantity of azote.

This experiment was repeated three times, with nearly the same results. Lavoisier does not state the specific gravity of the alkohol that he used, and therefore this experiment cannot be compared with his with any exactness. If we suppose its specific gravity was that which Brisson stated to be the purest then known, viz. 0,829, and which, according to Richter's tables contains 85,63 per cent. of pure alkohol, there would exist a great difference.

Some persons suppose that alkohol is altered, and approaches to ether, by distillation over muriate of lime: but when a similar experiment was made on the combustion of alkohol, obtained by simple rectification, and of the specific gravity of 0,8248 at 15° Reaum. the results were almost exactly similar to those of the former experiment, allowance being made for the 12,8 per cent. of water that the alkohol contained, according to Richter's tables. Indeed the alkohol rectified over muriate of lime had the same smell as the other, it combined with water in any proportion, and followed the same laws as to the alteration of volume by this union It had no more expansibility than ordinary alkohol. It formed indeed a little soot, but this is also formed by ordinary alkohol when burned with the same kind of stifled flame. Ether itself sometimes forms soot, and sometimes not, according as the air has more or less access to the flame. It is indeed true, that the muriate of lime upon which alkohol had been twice distilled, left, when dissolved in water, some slight traces of a black substance, which may arise from the decomposition of a very small and inappreciable portion of alkohol.

As alkohol impregnates atmospheric air and oxygen with a vapour that causes them to detonate, this processwas employed to ascertain the composition of alkohol. 1000 cubic inches of atmospheric air, at 17° Reaum. and at 26 in. 9 l. pressure, weighed 424½ grains; but when this air had been saturated with alkoholic vapour, 1000 cub. in weighed, in the same circumstances 433,78 gr. It was also found that a drop of alkohol being introduced into a barometer, depressed the quicksilver 20½ lines; whence on Mr. Dalton's principles, it may be concluded that 1000 cub. in. of alkoholized air contain 936,14 cub. in. of atmospheric air, and that 1000 cubic inches of alkoholic vapour weigh 36,38 grains.

Oxygen was saturated with the vapour of alkohol by passing some alkohol up into a jar of oxygen standing in quicksilver, the superfluous alkohol being abstracted by blotting paper. But as this alkoholized oxygen would not detonate by the electric spark in Volta's eudiometer, 99,2 parts of hydrogen were added to 500 of the alkoholized oxygen. This mixed gas, after detonation left a residuum of 342,59 of oxygen, and 46,69 of carbonic acid. No account is here taken of the azote concerned in the experiment, and there must also be added the formation of a certain quantity of water. From this experiment, alkohol appears to be composed of 42,82 per cent. of carbone, 10,18 of hydrogen, and 47 of water; or substituting the elements of water for water, 42,82 of carbone, 15,82 of hydrogen, and 41,36 of oxygen.

According to this statement of the composition of alkohol, 100 grains thereof, consume during combustion 385.4 cubic inches of oxygen, and form 236.7 cubic inches of carbonic acid gas, along with about 132 gr. of water. Lavoisier collected only 116 gr. of water, the remainder was carried off through the worm employed to condense it. The water collected by burning alkohol under a glass receiver was insipid, and had no effect upon syrup of violets, infusion of litmus, acetate of barytes, nitrate of silver, nor lime water. Two ounces of this water slowly evaporated, left $\frac{1}{8}$ grain of a transparent substance, which attracted the moisture of the air. This substance being dissolved in water, was rendered turbid by oxalate of potash, and it appeared to be a mixture of lime and potash dissolved in the acetic acid formed during the combustion of the alkohol. The water kept in a vessel half full, deposited after some months a little mouldiness; it also formed an ammoniacal cloud, when muriatic acid was brought near it, particularly when the water had been collected by a worm, as in that case the acetate of ammonia had less time to be evaporated. A few drops of muriatic acid being previously put into the receiver connected with the worm, there was formed $3\frac{1}{4}$ grains of muriate of ammonia in $4\frac{1}{4}$ ounces of water, besides the muriate that was lost in the operation, and a small quantity of muriate of lime, and muriate of lead. The latter came from the worm, for the water collected under a glass receiver, did not yield a black precipitate with hydrosulphuret of potash, as that collected by a pewter worm. The ammonia thus formed did not arise from the azote of the atmosphere, but from that contained in the alkohol. Mr. Thenard found that azote was a necessary ingredient in ferments, but that it disappeared during fermentation; the present experiments show that it goes into the alkohol. The ammonia formed during the combustion of alkohol, is probably united with acetic acid, for on adding a few drops of a solution of potash to 2 ounces of the water formed during its combustion, there was obtained by slow evaporation about $1\frac{1}{4}$ grains of acetate of potash.

These ingredients are found in such small quantities, that no great error was committed by considering the product in the former deductions as pure water.

2183 grains of alkohol were slowly distilled, and the vapours were made to pass through an ignited tube of porcelain, glazed internally, and then through a glass worm immerged in water into a small receiver, from whence a tube conducted the aeriform products to a pneumatic trough: $4\frac{1}{4}$ grains of charcoal were found in the porcelain tube; this charcoal left 1 grain of ashes containing potash, lime and silica: 4 grains of a mixture of a crystallized essential oil with a thick brown oil were collected partly in the worm, and partly in the receiver; 196 grains of water were collected, of the specific gravity of 0.998, and which consequently contained $2\frac{1}{2}$ grains of undecomposed alkohol: This water had the odour of benzoin and vinegar, and appeared to contain about $\frac{1}{100}$ of a mixture of much acetic acid and ammonia, and probably some benzoic acid. In addition to this, there was also collected 7199 cubic inches of oxycarburetted hydrogen, at 27 inches pressure, and 17° Reaum. which weighed 1786.61 grains. So that there was a loss of 192.14 grains occasioned by a dense white fume, which smelled like benzoin, and was carried into the pneumatic apparatus along with the gas, where it was absorbed by the water in the trough. As the oxycarburetted gas did not yield more carbonic acid, on being detonated before this fume has subsided, than afterwards, it was probably mostly aqueous.

The oxycarburetted hydrogen obtained in this experiment, did not contain any carbonic acid. On a medium of 18 experiments made on this gas collected in as many jars, 100 parts in volume mixed with 200 of an impure oxygen gas containing 10 of azote, and detonated, left a residuum of gas, which on being analysed, contained 78 of carbonic acid, 65.93 of oxygen, 12.57 of azote, in all $156\frac{1}{2}$; besides these gases, there was a formation of water.

From these experiments, allowing the oil to contain $\frac{1}{4}$ hydrogen, and $\frac{3}{4}$ carbone, it appears that alkohol is composed of 43.65 per cent. of carbone, 37.85 of oxygen, 14.94 of hydrogen, 3.52 of azote and 0.04 of ashes; a result which agrees very well with the analysis of alkohol by the combustion of its vapour, if the quantity of azote now ascertained be allowed for. A similar analysis made of alkohol, rectified by distillation only, gave nearly the same result, on making due allowance for the water which that alkohol contained.

100 parts in weight of sulphuric acid, mixed with an equal weight of alkohol of the specific gravity 0.842 at 16° Reaum. yielded 53 of unrectified ether, whose specific gravity was 0.797. This ether, rectified off the alkoholic solution of potash to one half by a heat of 35° Reaum., acquired the specific gravity of 0.740. This rectified ether being washed with twice as much water, acquired the specific gravity of 0.726, and on $\frac{3}{4}$ being drawn off, the specific gravity of that portion was only 0.717 at 16° Reaum.

The results obtained by burning the last mentioned ether in a lamp were still less satifactory than those from alkohol; and are therefore omitted.

1103 grains of ether being passed through an ignited glazed porcelain tube, was entirely decomposed, so that no ethereal smell was perceived in the apparatus, $5\frac{1}{2}$ grains of charcoal were found in the tube, this charcoal on being burnt, left no ponderable quantity of ashes. There was also collected 3 grains of crystallized essential oil smelling like benzoin, and 43 grains of an almost black oil, which also had the odour of benzoin, as well as 3 grains of water found in the worm. Lastly, 3541 cubic inches of oxycarburetted hydrogen gas, without any mixture of carbonic acid, was produced, and drew along with it a thick yellow fume, smelling strongly of benzoin and empyreuma. This fume was absorbed by the water in the trough, and left on it an insoluble pellicle. As the oxycarburetted hydrogen gas, detonated before this fume was deposited, yielded more carbonic acid than afterwards, it appeared that this fume was oleaginous. On a medium of three weighings, this oxycarburetted hydrogen gas weighed, after the deposition of the oil, 948 grains; whence the oily vapour may be estimated at $100\frac{3}{4}$ grains.

100 parts in volume of oxycarburetted hydrogen gas, on being detonated, consumed 145 of oxygen, and produced 88 of carbonic acid, with some water; but no azote made its appearance; that mixed with the oxygen was somewhat diminished, whence, it may be concluded, that 100 parts in weight of this oxycarburetted hydrogen, contains 56.12 of carbone, 17.43 of hydrogen, and 26.45 of oxygen.

From the great quantity of this gas and of oil that was produced from ether, it is evident that ether contains more carbone and hydrogen, with less oxygen than is contained in alkohol.

The crystallized oil obtained in this experiment, was in transparent flakes, very inflammable, and soluble in alkohol, from whence it was precipitable by water. It was volatile in the temperature of the atmosphere, and left the brown empyreumatic oil, which had fouled the crystals The dark oil was partly liquid, and partly as thick as honey. It was very acrid, and when spread on paper, it dried, and left yellow microscopic crystals that were not volatile in the temperature of the atmosphere. The drop of water that was obtained scarcely altered infusion of litmus, if it produced any effect, it rendered the infusion red, but it yielded vapours on the approach of muriatic acid. As to the oxycarburetted hydrogen gas, its specific gravity varied from that stated by the Dutch Chemists, as well as from that stated by Cruikshanks; indeed its specific gravity varies according to the degree of heat, the diameter of the tube, the inclination thereof, and other circumstances.

The experiments relative to the analysis of ether by the detonation of its vapour, were made under the pressure of 27 inches at 18° Reaum. A drop of ether introduced into a barometer depressed the quicksilver, 16 inches + 9 lines, of course 1000 cubic inches of etherized atmospheric air, will contain 379.63 cubic inches of air, weighing 161.9 grains; while the 1000 cubic inches

of etherized air, weighs 816.37 grains, so that it contains 654.47 grains of ethereal vapour.

Etherized oxygen does not detonate by the electric spark, but requires an additional quantity of oxygen; differing in this respect from alkoholized oxygen in which the superabundant of the oxygen produces a similar effect. If only a sufficient quantity of oxygen is added to the etherized portion, there is deposited during detonation, a black powder on the sides of the eudiometer, but this deposition does not take place when an excess of oxygen is added.

100 parts in volume of etherized oxygen, was detonated with 504 of oxygen; water was formed, and the residuary gas being analysed, contained 230.51 parts of carbonic acid, and 113.80 of oxygen. Whence, 100 parts of ether appears to contain 59.04 of carbone, 21.86 of hydrogen, 19.1 of oxygen. And it also appears, that 10 grains of ether require for their combustion 61 cubic inches of oxygen, at 28 inches pressure, and 10° Reaum. that they produce water, and 32.85 cubic inches of carbonic acid gas.

On a medium of four repetitions of these experiments, ether appeared to contain 58.2 per cent. of carbone, 22.14 of hydrogen, and 19.66 of oxygen.

In the above analyses, the water obtained in the analysis of ether has been considered as pure.

By burning several ounces of ether in Meusnier's apparatus, a sufficient quantity of water was procured, which had a slight empyreuma, but was not affected by nitrate of silver, lime-water, nor even by acetate of barytes, until it was reduced by evaporation to $\frac{1}{5}$ of its volume, and then the acetate of barytes produced a slight cloud in it. Hydrosulphuret of potash threw down a dark brown precipitate, being the lead extracted from the worm. This water slightly rendered syrup of violets green, and it produced dense fumes on muriatic acid being brought near it. When a few drops of muriatic acid, was put into the receiver previous to the combustion of the ether, to combine with the ammonia and prevent its being evaporated, 1.3 grains of an ammoniacal salt was obtained by the evaporation of an ounce of the new formed water, mixed with a little muriate of lead. Some of this ammonia originated probably from the azote mixed with the oxygen that served for the combustion of the ether. This ammonia was combined with acetic acid, for on adding potash to 288 grains of the water, it yielded $\frac{1}{10}$ grain of a white deliquescent salt that had all the characters of acetate of potash. 288 grains of another parcel of this water left on evaporation $\frac{1}{8}$ grain of a transparent varnish, which became moist in the air.

The sulphuric acid, acetate of potash, and deliquescent varnish, are, however, contained in such small quantity in the water obtained for the combustion of ether, that it cannot produce any great alteration in the proportion of ingredients in the ether itself.

A current of oxymuriatic acid gas being passed for 10 hours through

a solution of an ounce of ether in 14 oz. of water; the ether was partly decomposed, but yet the solution did not precipitate acetate of barytes, until it was reduced by evaporation to a $\frac{1}{4}$ of an oz.; so that the properties of sulphuric ether cannot depend on the presence of that acid.

Ether therefore contains much more carbone and hydrogen, but much less oxygen than alkohol, and yet the residuum contains a bituminous or resinous matter loaded with carbone.

100 parts of alkohol whose specific gravity was 0.845, and which of course contained 80 of pure alkohol, yielded by three distillations with sulphuric acid, 38 75 parts of unwashed ether, whose specific gravity was 0.726 at 16° Reaum. From this we may conclude that 200 parts of alkohol would produce 100 of ether of the specific gravity of 0.717 at 16° Reaum. and therefore the change is produced by the abstracting 28 parts of carbone, 57 of oxygen, 8 of hydrogen with some azote. The oxygen and hydrogen are nearly in the proportion to form 65 of water. The carbone is found in the residuum, but each of the products are mixed with some portion of the others.

A vessel of the capacity of a cubic foot, whether empty or full of air will contain at 18° Reaum. nearly 2 oz. of ether in the state of gas. Ten measures of atmospheric were augmented to 20 by the vapour of ether; these 20 measures occupied a cylinder 6 inches long, and $\frac{1}{2}$ in diameter, and were reduced to 11 by 12 gr. of dry resin being added to them. The same quantity of air impregnated with ether, was reduced to 13 by 12 grains of tallow, which became soft; to 15 by 12 grains of caoutchouc; to 16 by 12 grains of camphor, which became moist; to $16\frac{1}{2}$ by 12 grains of yellow bees wax; to 19 by 12 grains of gum lac; but gum tragacanth produced scarcely any diminution.

The vapour of water is lighter than that of alkohol, and still more than that of ether; hence, the specific gravity of vapours, appears to be an (inverse) ration of the volatility of the liquids by which they are produced. If therefore the aeriform fluids did not intercede each other, but arranged themselves, like grosser liquids, according to their specific gravity, the vapours of the least volatile bodies, as earths and metals, would occupy the highest strata of the atmosphere.

Chemical Analyses of Bone and Teeth. By Mr. Berzelius.—*Journ. de Phys. April* 1807.

These analyses are contained in a letter from Mr. Gehlen to the editor.

The enamel of human teeth contains 85.3 per cent. of phosphate of lime, 3.2 of fluate of lime, 8 of carbonate of lime, 1.5 of phosphate of magnesia, 2 of soda, animal parts, and water.

The enamel of the teeth of oxen contains 81 per cent. of phosphate of lime, 4 of fluate of lime, 7.1 of carbonate of lime, 3 of phosphate of magnesia, 1.34 of soda, 3.56 of animal parts.

The boney part of human teeth contains 61.95 per cent. of phosphate of lime, 2.1 of fluate of lime, 5 3 of carbonate of lime, 1.05 of phosphate of magnesia, 1.4 of soda with a little muriate of soda, 28 of gelatine, veins, and water.

The boney part of the teeth of oxen, contains 57.46 per cent. of phosphate of lime, 5.09 of fluate of lime, 1.38 of carbonate of lime, 2.07 of phosphate of magnesia, 2.4 of soda with a little muriate of soda, 31. of gelatine, veins, and water.

Dry fresh human bones contain 51.04 per cent. of phosphate of lime, 2 of fluate of lime, 11 3 of carbonate of lime, 1.16 of phosphate of magnesia, 1.2 of soda, with a little muriate of soda, 32.17 of gelatine, and 1.13 of veins.

Dry fresh beef-bones contain 55.45 per cent. of phosphate of lime, 2.9 of fluate of lime, 3.85 of carbonate of lime, 2.05 of phosphate of magnesia, 2.45 of soda, with a little muriate of soda, and 33.3 of gelatine and veins.

Observations.—We wait with impatience for the details of these experiments, as the existence of fluoric acid in bones has been denied by Fourcroy, Hatchett and Brandé; as may be seen by the extracts we have given of their papers on this subject. Vol. II. p. 57, 58.

On the Solubility of some of the Earths by Means of Sugar. By William Ramsay.—*Phil. Journ.* No. 76.

Quicklime added to a cold solution of sugar, communicated to it a caustic taste; and the diluted sulphuric acid precipitated a considerable proportion of sulphate of lime.

The solution of sugar in lime-water, had only the ordinary taste of syrup, and yielded hardly any precipitate with sulphuric acid.

The specific gravity of a solution of common unrefined sugar in rain water, at 50° Fahr. was 1,010. Quicklime being added to this solution, at different times, until the solution was saturated, encreased the specific gravity to 1,060; whence Mr. R. infers, *that sugar at 50° Fahr. is capable of dissolving half its weight of lime.* The solution of sugar boiled on quicklime dissolved but little of it, as only a slight cloudiness was produced by the dilute sulphuric acid; the oxalic acid threw down about twice as much oxalate as would have been precipitated from an equal quantity of lime-water.

The solution of lime in a solution of sugar is of a beautiful white-wine colour, and has the smell of fresh slacked lime. The lime is precipitated by the carbonic, citric, tartareous, sulphuric, and oxalic acids; and the solution is decomposed by caustic and carbonated potash and soda, the citrate, tartarite, and oxalate of potash, &c.

Strontites (from whence the carbonic acid had been expelled by nitric acid) added to the cold solution of sugar, encreased the spe-

cific gravity to 1,050. The solution boiled on a fresh portion of earth, and filtered, remained of a white-wine colour, but as it cooled, it deposited gray-coloured crystals, redissoluble in water, and having the same taste as the saccharine solution of strontites. The specific gravity of this solution, at 50° Fahr. was 1,080, whence Mr. R. infers, that *sugar at 50° will dissolve an equal quantity of strontites.* The solution has a peculiar caustic smell. The earth is precipitated by caustic and carbonated potash and soda; also by the carbonic, citric, tartareous, sulphuric and oxalic acids; and the citrate, tartarite, and oxalate of potash.

Barytes was treated with nitric acid in order to expel the carbonic acid, and put in a cold solution of sugar, carburetted hydrogen gas was disengaged, and the solution became of a dull green, which afterwards went away, a black matter being precipitated. The specific gravity of the solution was not altered, but on its being boiled on a fresh portion of earth, the specific gravity, at 50° was 1,046. The barytes left on the filtre was found to have acquired carbonic acid. It is probably, therefore, that barytes decomposes the sugar, uniting with part of the carbone, while the oxygen uniting with the hydrogen, and the remainder of the carbone, is disengaged as carburetted hydrogen gas.

Calcined magnesia, added to a solution of sugar, without heat, did not encrease the specific gravity; but on the liquor being boiled, filtered, and cooled to 50°, the specific gravity was 1,043. The solution was of a white-wine colour; the original sweet taste was much improved; the magnesia was entirely separated by its remaining at rest for some months.

The solution of sugar dissolved very little newly-precipitated alumine; and when the "*saccharite*" of lime was decomposed by sulphate of alumine, the lime and alumine were precipitated together. The solution of sugar boiled, however, on newly precipitated alumine seemed to be rendered purer, by the alumine combining with the colouring matter of the sugar.

The carbonates of potash and soda decompose the solutions of lime and strontites in a solution of sugar, by the alkalies abstracting the sugar, while the carbonic earth unites with the earth.

When *weak* sugars are dissolved in water, a gray precipitate falls down, which probably arises from a superabundance of lime having been employed in preparing them: the precipitated matter being carbonate of lime. A solution of lime in a solution of sugar being kept for 4 years in a bottle closely corked, deposited a yellowish crust of carbonate of lime.

Observations.—We can by no means agree with Mr. R. in his calculation of the quantity of the various earths dissolved in the solution of sugar, from the increased specific gravity of the liquid, as it is well known that every chemical combination is attended with condensation or expansion, so that nothing can be inferred from the specific gravity of the mixture, as to the proportion of its constituent parts.

Researches on the Assimilating Power of Vegetables. By Mr. HENRY BRACONNOT.—*Ann. de Chim. February* 1807.

VAN HELMONT, and Boyle, deduced from their experiments, that plants were nourished by water alone; and Duhamel and Bonnet found that plants grew very well in moss moistened with distilled water, while, at the end of the experiment, the water was as limpid as before. Mr. Procopius de Denzidoff even employs this method to convey rare plants to his botanic garden, at Moscow.

Other experimenters have reared plants in different substances, insoluble in water; and some have inferred, from analytical experiments made on the plants thus raised, that they do not contain the usual proportion of carbone, and that, on the other hand, plants grow in the open ground with a vigour proportioned to the quantity of carbone which is presented to their roots in a very divided state, or in solution.

To examine how far this opinion was true, Mr. B. first investigated the composition of perfectly rotten garden mould. Some very pure, black pulverulent mould taken from the roots of an old tree being boiled in water did not discolour it, nor yield any soluble parts. 1000 decigrammes ($3\frac{1}{4}$ oz. Troy) were reduced to 200 by drying; and this residuum yielded on distillation, 40 decigrammes of water, strongly reddening the tincture of litmus, and containing empyreumatic acetous acid partly combined with ammonia, 20 decigrammes of a dark-brown acrid oil, which became solid on cooling, 89 cubic inches of oily hydrogen gas, burning with a blue flame, 34 cubic inches of carbonic acid gas, and 85 decigrammes of carbonaceous residuum, which yielded 24 decigrammes of light yellowish ashes. Water boiled on these ashes acquired no taste, it was not precipitated by the nitrate of barytes, or nitrate of silver, and it yielded a very slight cloud on the addition of oxalic acid. Muriatic acid left 13 decigrammes of silica undissolved, the solution itself being examined by different precipitants, yielded some traces of alumine, 2 decigrammes of oxide of iron, containing a little oxide of manganese, $2\frac{1}{2}$ decigrammes of phosphate of lime, 4 of carbonate of lime, and some traces of carbonate of magnesia.

6 grammes ($92\frac{1}{2}$ grains Troy) of the same mould were boiled in a strong ley of pure potash for an hour; the ley was then diluted with water, and filtered. The liquor was dark-brown, and yielded, by the addition of an acid, 1 gr. of a very deep black precipitate, in brilliant scales, which exhaled scarcely any thing, when placed on a burning coal. The residuum that had been treated with potash, perfectly resembled mineral coal. A discovery which may tend to explain several geological facts.

Although this mould did not contain any thing soluble in water, plants grew in it with vigour, and yielded a quantity of potash: so that the common opinion of the action of manures seems unsatisfactory. And Tillet and Parmentier seem to be right in supposing, that manures serve only to retain water, and to loosen the soil. That only water and the air are the essential agents in vegetation is shewn by the following experiments.

400 seeds of white mustard weighing 22 decigrammes (33 gr. Troy) were sown in litharge, and supplied with distilled water. When full grown, the plants after being well washed, and wiped, weighed 2640 decigrammes. On being dried, the weight was only 342 decigrammes, which left, after distillation, 120 decigrammes of charcoal, and this on incineration was reduced to 42 decigrammes of ashes, which yielded to water 22 decigrammes of saline matter, of which $5\frac{9}{10}$ appeared to be sulphate of potash, and $6\frac{7}{10}$ potash. The residuum contained 4 decigrammes of silica, 13 of carbonate of lime, $4\frac{1}{2}$ of a mixture of oxide of iron, alumine, and phosphate of lime, with some traces of carbonate of magnesia.

250 seeds of white mustard were sowed in sublimed sulphur, that had been washed, and supplied with distilled water. The vessel was covered with a glass bell to diminish the prompt evaporation of the water which was retained very slightly by the sulphur. The plants produced fruitful seeds, and weighed 1080 decigrammes, but diminished to 186 decigrammes by drying. They left 78 decigrammes of charcoal on distillation, which yielded $15\frac{1}{2}$ decigrammes of whitish ashes. The soluble part of the ashes weighed 6 decigrammes, and was a mixture of carbonate and sulphate of potash. The residuum was similar to the former.

100 seeds of white mustard were sown in very fine small shot not polished, and supplied with distilled water. They flowered, and yielded pods, but they were very weak plants, as their roots could not penetrate the dense mass of shot. The plants weighed 100 decigrammes, and diminished to 23 by drying, They yielded but a small quantity of charcoal, yet more than the original seeds.

Radish seeds sowed on a heap of well washed river sand, in a paved yard, and supplied with rain-water produced radishes, superior in taste to those grown in gardens, in the same manner as asparagus succeeds well in sand, and potatoes grown in that soil are the best tasted. The radishes growing at the top of the heap were the largest and finest. 3720 decigrammes of dried plants left 542 decigrammes of grey ashes, which yielded on elixiviation 186 decigrammes of saline matter containing 67 decigrammes of pure potash, $73\frac{1}{2}$ decigrammes of sulphate of potash, a small quantity of phosphate of lime, and carbonic acid. The potash appeared to be combined with nitric acid.

The same quantity of dried radish plants, that had been reared in garden mould, left 340 decigrammes of ashes, which yielded 160 decigrammes of a mixture of carbonate, and sulphate of pot-

ash. A strong smell of ammonia was perceived when a little water was poured upon the coal while hot, which might occasion the difference in the proportion of fixed alkali in these cinders.

Potash appears to abound in plants of the class tetradynamia; indeed, most acrid and bitter plants contain a quantity of potash; in some, as simsybrium nasturtium, &c. it appears to have been combined with nitric acid. But the potash which is contained in wormwood is not combined with that acid; but with a peculiar matter, which falls down from a decoction of the fresh plant, and may be separated in abundance by the nitráte of lead. This matter is very soluble in the alkalies, and is perhaps the same as that discovered by Vauquelin in some varieties of quinquina.

That the earths left after the extraction of the saline matter were not absorbed from the sand, but like the other principles produced by vegetation, seems to be indicated by their having their peculiar seats in the plant. Thus silica is distributed on the surface and leaves of plants, lime affects the centre, and is yielded abundantly by hard wood. So also phosphorus is found plentifully in the seeds, those of mustard and wheat are said by Margraff to afford it by distillation, while the stalks do not contain any of it. Vauquelin also has found phosphate of lime in oats, and carbonate of lime in oat-straw.

It appears, therefore, that the earths, alkalies, acids, sulphur, phosphorus, and even the metals found in plants nourished only by water, should be considered as produced by the vital power with the assistance of light and caloric forming combinations of hydrogen and oxygen in peculiar states of condensation.

If hydrogen forms a constituent part of potash, as it does of ammonia, it might, perhaps, be discovered by the same means as those by which the existence of hydrogen in charcoal has been ascertained. Dolomieu and Pelletier have, in fact, procured hydrogen by heating fresh prepared potash with quartz in close vessels.

The earths are the only substances, reputed simple, that do not combine with oxygen; which may arise from their being already saturated with it. At any rate, we ought to suppose that the substances, now reputed to be simple, are not so; although it will be long before we shall be able to explain how the hydrogen and oxygen of water form the greatest part of natural bodies by the intermedium of organised ones.

These changes of water revive in some measure, the opinion of Thales, and would serve as a basis of a geological system, in which the mineral kingdom might be regarded as the residuum of the organic beings that are constantly employed in decomposing the water on its surface, and converting the water into earthy or other matters. As an animal deprived of nourishment languishes and dies, so may the globe itself when the water is exhausted.

Vauquelin has discovered that lime and phosphorus is formed by animals, but experiments on vegetables are still more decisive, as they may be nourished by water alone. Some animals, as fishes,

may also be nourished by water; indeed that fluid constitutes the greatest part of all our aliments, for those substances, which like gelatinous or farinaceous matters, possess the nutritive powers in a superior degree retain water in that state of division which is most favourable for its decomposition, in the same manner as garden mould seems to contain water in a state fit for supplying nourishment to plants.

Carbone has been supposed the basis of organic bodies, and several philosophers, as Hassenfratz, Kirwan, &c. have held different opinions as to the source from whence they derived that principle. Some have thought the effects of dung in agriculture depended upon its furnishing a solution of carbone, that might be absorbed by plants. Duhamel and Sennebier have, however, shewn pure water to be more efficacious in vegetation than dung-hill water; and that all impregnations of water with salts, or other matters are injurious to plants growing in it. Branches of elder and fig trees being plunged into diluted ink for several days, none of the colouring matter appeared in the bark, which is the principal seat of assimilation, nor in the pith, but solely in the wood towards the base, so that its absorption was purely mechanical.

That the soil is rendered more fit for the nourishment of plants by being despoiled of the soluble remains of organic bodies is rendered farther evident by the good effects produced by paring and burning especially as the effects are peculiarly evident on the spots where the fires were made, and Maxey has found that dung is detrimental on land, which has been pared and burnt, occasioning the production of straw instead of grain.

These good effects, which follow paring and burning, arise, it is probable, from the combustion and destruction of the excrementitious parts of plants, which injure the growth of other vegetables. The earth next the roots of plants becomes greasy, and sometimes dark-coloured. In many of the euphorbiae and cichoraceous plants, this excretion is milky, and easily perceived. It is also peculiarly evident on the roots of plants that grow in water, and is perhaps the cause why some plants are never found growing together.

The charcoal produced in paring and burning cannot be the cause of the fertility thence arising, as Chaptal has shewn that dry charcoal mixed with earth is not absorbed by plants; and large trees, are found on rocks, or walls, as also immense forests on sandy plains.

Saussure imagined plants absorbed their carbone from the atmosphere; and he endeavoured to support his opinion, by shewing that lime placed in receivers, prevented the growth of plants inclosed along with it, and even destroyed them in a few hours. That this was owing only to the vapour of the lime, is shewn by the following observations.

Paper tinged with litmus, and rendered red by an acid, on being suspended over moistened lime, in a close vessel soon regained its

blue colour. Water abstracted from lime acquired an unsupportable smell, a disagreeable taste, and restored a blue colour to paper reddened by acids. Alkohol abstracted from lime appears to take up a still greater quantity, for when Proust added a handful of lime to 25lb. of wine previous to distillation, in order to obtain alkohol free from acetous acid, the brandy had a strong smell and taste of lime, which did not leave it on rectification: the alkohol thus made was precipitated by metallic solutions and oxalic acid, and restored a blue colour to paper reddened by acids. In the same manner water abstracted from potash was found to carry over some of the alkali, and when abstracted from common salt, it afforded a precipitate, with nitrate of silver, but no acid taste was observed, as had been stated by Homberg.

Neither are lime, or alkalies, the only bodies that are poisonous to plants by their corrosive vapour; for the Dutch chemists found that plants were killed by being confined in a receiver along with a bottle of quicksilver, although the air in the receiver had a free communication with the atmosphere.

Sennebier and Hubert have shewn that germination does not take place in seeds exposed to the vapours of sulphuric ether, camphor, oil of turpentine, assafœtida, vinegar, ammonia, or putrid bodies, so that the same substances that affect animals appear to have an equal action on plants.

Priestley found that an eighth part of carbonic acid gas killed two plants of mint, although exposed to a large surface of water. As oxides of lead absorb carbonic acid gas with avidity, and might by this means afford some instruction in regard to the effect of that acid in vegetation; some newly prepared oxide ad minimum of lead was moistened with distilled water, sowed with white mustard-seed, and immediately inclosed in a glass bottle. The strong smell exhaled by the moistened oxide indicated bad success, and indeed the seeds did not grow; but every one of them was covered with a brilliant coat of metallic lead, which was probably formed, along with water, by the oxygen of the oxide uniting with hydrogen, furnished by the seeds. When these seeds were sown in an oxide that had been exposed for some time to the air, the oxide was not reduced, and the seeds germinated.

Huyghens found plants would grow in a bottle, close stopped, and buried in the ground, although the air was not renewed. To shew therefore, that the carbone of plants is not absorbed from the carbonic acid gas in the atmosphere, Mr. B. poured into six white glass bottles, fine white sand, which had been washed with muriatic acid, to separate any calcareous earth that it might contain, sowed therein 460 seeds of white mustard, moistened them with distilled water, and closed the vessels, which were then buried a few inches deep in a moist soil. At the end of six weeks, the plants were taken out, washed carefully, and dried, They weighed 90 decigrammes, and yielded 48 of charcoal, which left 33 dec. of ashes strongly alkaline. The same number of mustard

seeds left only 4 dec. of charcoal, losing nearly half its weight by incineration. So that the seeds had acquired more than 10 dec. of charcoal, formed from the water and probably in part from the light.

These plants did not indeed grow so vigorously as in the open air, but this was not owing to the want of oxygen, for the air contained, after the experiment, nearly the same quantity of oxygen as before, Homberg found some grains to germinate *in vacuo*, and Sennebier says, peas shoot even under distilled water. This want of vigour is rather to be imputed to the excrementitious exhalations of the plants not being carried off, so that they had an injurious effect upon the plants, in the same manner as the miasmata excreted from the lungs of animals is hurtful to them. The air of hospitals, and of crowded theatres, scarcely differ in regard to the proportion of oxygen from the open air; and Lavoisier has shewn that animals can live in a mixture of 15 parts of azote with one of oxygen. Plants on the other hand, do not require azote, although they contain it, for they may be grown in a mixture of 3 parts of hydrogen with one of oxygen.

The combined force of light, and the organic action of plants in causing the elements of water to form the various substances produced from vegetables, was shewn by causing some of these seeds to grow in total darkness. They shot out long white threads, bearing at their extremity the seminal leaves, but the vegetation proceeded no further, and these shoots when dried, weighed less than the seed.

It appears that the light enters into the composition of plants, and produces the colour of their leaves and flowers. Humboldt has found however, green plants in deep mines, where hydrogen abounded, whence light and hydrogen appear to possess analogous properties, in this respect, as they were already known to do, in regard to some salts and metallic oxides.

Geological facts also render the theory of the separation of the carbone of vegetables from the carbonic acid gas of the atmosphere improbable, as that gas forms only a small portion of the atmosphere, and could never form those immense strata of coal and bituminous wood that are found in so many places, to say nothing of the vegetable clothing of the globe.

If light, and the elements of water can form carbone, the latter may be supposed to contain hydrogen, which might be separated from it, by applying a substance that has a strong attraction for hydrogen. Berthollet obtained by strong heat 100 cubic centimetres ($3\frac{1}{4}$ oz. measure) of hydrogen, from a mixture of 30 grammes (1 oz.) of calcined charcoal, and 20 of sulphur. It is probable that charcoal might be entirely decomposed by repeating this experiment several times with the same charcoal.

Water is produced by the application of oxygen to ignited charcoal, as has been shewn by Lavoisier and Hassenfratz. Analogous results have been obtained with metallic oxides by Cruikshanks.

Biot and Arrago also conjecture that the diamond, which is considered as pure carbone, contains a large proportion of hydrogen, on account of its high power of refraction.

Upon the whole, it may be concluded that plants require only water for their nourishment, as mould contains no soluble principle, and can only yield to plants the water which it retains in a peculiar state of division. Vegetables can also grow in any substance that does not act upon them, and is insoluble in water; and their organic powers aided by solar light is capable of producing the various substances found in them, as the earths, alkalies, metals, sulphur, phosphorus, charcoal, and perhaps azote, so that oxygen, hydrogen, and fire, appear to be the only real elements of the universe, and nature performs the greatest variety of effects by the slightest modification of the means she employs.

Observations.—Although there is nothing in Mr. Braconnot's experiments which appears to have required the exertion of any superior power of mind, or of any uncommon depth of chemical knowledge, yet their importance appears to us to be as great as if more considerable difficulties had attended their execution; and he has certainly shewn a sufficient acquaintance with the subject to constitute him a good judge of the competency of chemical evidence, nor have we any reason to doubt the veracity of this relation. These experiments must, therefore, be considered as finally determining a point which has long been disputed by physiologists and by chemists; the greater number of physiologists being persuaded of the unlimited power of life over matter, while the generality of chemists on the other hand, have been unwilling to concede to the operations of the living laboratories of nature, a greater influence than is possessed by the processes of art. But *naturam expellas furca tamen usque recurret*, and Braconnot has the honour of leading her back in triumph.

The late astonishing discoveries of our countryman Mr. Davy have rendered the apparent formation of potash from oxygen and hydrogen still more interesting, though perhaps not more intelligible. If Mr. Braconnot's experiments only tended to establish this fact, it might be conjectured, that the metal obtained by Mr Davy from potash, stands in the same relation to hydrogen, that the diamond was once supposed to do to common charcoal; and it might by a still stronger effort of imagination be advanced as possible, that the metal obtained from soda might be similarly connected with the muriatic acid; but Mr. Braconnot thinks, that he has shewn that many other metals may be formed by similar processes out of the same elements; and if we grant this, the only legitimate inference that can be drawn is, that life is a process which may be called metachemical, in the same way as the term metaphysics is applied to those objects which exceed the limits of physical science.

The use that is made by Mr. Braconnot, of the opinion of Mill, Biot, and Arrago, respecting the diamond, does not seem to be

perfectly justifiable; they imagine that the diamond contains hydrogen, not on account of the intimate connexion between carbone and hydrogen, which Mr. Braconnot is endeavouring to establish, but because of the great diversity which they suppose to exist between the refractive powers of these substances, and of the approach of the refractive powers of the diamond to those of hydrogen. But the foundations of their reasoning are defective, since many bodies consisting principally of carbone possess refractive powers as great as those which contain a much greater proportion of hydrogen; and the error of the conclusion has been sufficiently shewn by the accurate experiments of Mr. Allen and Mr. Pepys. We are also at a loss to understand why many modern Chemists have been disposed to believe that the matter of light becomes a component part of bodies which have undergone certain changes when exposed to its influence, any more than that a portion of caloric should become fixed during all such operations as cannot be conducted, when all the substances concerned are in a state of congelation.

Observations on Oxgall. By Mr. Proust.—*Journ. de Phys. February* 1807.

Acids precipitate from oxgall a resin, which, when it has been well washed may be drawn out in threads like turpentine. When dried it is semitransparent and greenish. It melts in a very low temperature, and exhales an aromatic odour. It is soluble in alkohol, and precipitated from it by water. Oxygenized muriatic acid bleaches it. Distilled by a slight heat, it yields some water, and remains liquid, a stronger heat brings over a thick oil with a disagreeable animal odour, and a little carbonate of ammonia; a very small quantity of charcoal is left. It is soluble in very weak alkalies, from which it is separated without alteration by acids.

This resin is not always alike, for sometimes it is half fluid, and will not acquire the consistence of the former kind.

To obtain the pure resin, the dried gall is to be treated with alkohol, in order to separate the albumen, after which it is no longer subject to spontaneous decomposition.

Observations on the Antophyllite. By Mr. J. C. Delametherie. *Journ. de Phys. April* 1807.

The antophyllite is found at Konigsberg in Norway. It has the appearance of asbestoid or strahlstein. It crystallizes in prisms, It is brown, green, drawing a little upon violet. Its specific gravity according to Karsten is 3.156.

Dr. John of Berlin has found that it contains 62.66 per cent. of silica, 13.23 of alumine, 12 of oxide of iron, 4 of magnesia, 3.33 of lime, 3.25 of oxide of manganese, 1.43 being lost.

This analysis corroborates its affinity to asbestoid.

On Vegetable Mucilages. By Dr. JOHN BOSTOCK.—*Phil. Journ.* No. 76.

THE term mucilage, being used in a vague sense, Dr. B. examined the principal substances which pass under that name, and those analogous to them.

10 drops of a solution of acetate of lead, added to one drachm of a solution of 1 part of gum arabic in 10 of water, produced a copious dense precipitate. No effect was produced by superacetate of lead, nor by the nitromuriates of tin, or of gold. Nitrate of quicksilver flung down a white precipitate, redissoluble by agitating the solution, and reproducible by the addition of water, assuming, in a few hours, a pale pink colour. Oxysulphate of iron formed an orange colour precipitate in small quantity; but in 24 hours, the whole liquid became opake. Silicated potash produced an opacity immediately; and at length a precipitate fell down. Equal parts of alkohol produced a pulverulent precipitate immediately; which rendered the fluid opake, but the same proportion of infusion of galls produced no effect.

Oxysulphate of iron added to a solution containing $\frac{1}{6}$ of gum converts the whole into a solid transparent orange-colour jelly.

Alkohol added to a solution containing only $\frac{1}{1000}$ of gum no longer produces any effect; but a strong solution is converted into a white opake fluid.

Acetate of lead does not produce a precipitation in a solution of cherry-tree gum, but in 24 hours the gum appears to separate in fine threads. Nitromuriate of tin forms with it a solid light yellow jelly. Oxysulphate of iron only produces a blackish brown colour. Nitromuriate of gold renders it opake and light brown. Superacetate of lead, nitrate of quicksilver, and infusion of galls, produce no alteration. On adding alkohol some filaments are formed, but the greatest part of the solution seems to combine with the alkohol, although the solid gum is not at all soluble in alkohol.

The solution of cherry-tree gum kept in a warm atmosphere for some days, becomes slightly turbid, and a number of dark films are formed, which rise to the surface.

Tagacanth digested in water absorbs a large quantity, and becomes soft; if this soft pulp is rubbed with more water, a mucilage may be formed, which, if it contains $\frac{1}{1000}$ of tragacanth, is of the same consistence as though it contained $\frac{1}{10}$ of gum arabic. Acetate of lead produced a copious dense precipitate. Superacetate of lead coagulated it, and a precipitate was flung down in 24 hours. Nitromuriate of tin formed a firm coagulum. Nitromuriate of gold produced no effect, unless the mucilage was very dense, and then it became dusky gray, and afterwards blackish purple. Oxysulphate of iron changed the dense mucilage deep brown. Nitrate of quicksilver flung down a reddish precipitate. Silicated potash produced an opacity in the dense mucilage, as did also caustic potash.

Alkohol seemed to throw down a fibrous precipitate, because a greater opacity was produced than by the addition of water only, and after some time the solid matter separated Infusion of galls rendered it turbid, but this might be owing only to the water itself. Sulphate of copper did not throw down any precipitate.

A mucilage formed by adding linseed to 10 times its weight of water, is about the consistence of white of egg. It might be incorporated with any additional quantity of water. Acetate of lead threw down a copious dense precipitate. Superacetate of lead, and nitromuriate of tin produced a considerable opacity. Nitrate of quicksilver yielded a slight precipitate. Nitromuriate of gold, oxysulphate of iron and silicated potash produced no effect. Alkohol separated a fibrous substance, after some time. It is not precipitated by infusion of galls.

Mucilage formed by boiling quince seeds in 40 times their weight of water was of the consistence of white of egg, after being kept for some time it shewed a tendency to coagulation. It was not coagulated by silicated potash, or infusion of galls. Acetate of lead threw down a quantity of dense white flakes, the nitromuriate of tin had a similar effect, but the precipitate was not so dense. A less complete precipitation was produced by superacetate of lead, nitromuriate of gold, nitrate of quicksilver, and oxysulphate of iron. It is coagulated by acids, and alkohol has the same action on it, as on mucilage of linseed.

Roots of the common blue-bell, rubbed with 4 times their weight of water, formed an opake pulp, which in a few hours let fall a farinaceous substance, and on being filtered through paper became similar in consistence and appearance to mucilage of linseed, but had a tendency to putrefaction, as it soon exhaled a very nauseous odour. Acetate of lead threw down dense white films and flakes. Superacetate of lead threw down a precipitate in moderate quantity. Nitrate of quicksilver separated a light pink precipitate. Nitromuriate of tin yielded a copious white precipitate. Nitromuriate of gold yielded a light brown precipitate. Oxysulphate of iron yielded a brown precipitate. Infusion of galls caused a precipitation, but silicated potash had no effect. Alkohol separated both a pulverulent and fibrous precipitate. These results differ from those of Le Roux, Ann. de Chim. xl. 145, et seq.

Acetate of lead added to starch boiled in water threw down immediately a very dense precipitate, and the water was left nearly limpid. Nitromuriate of tin also caused a copious precipitation, but no effect was produced by the other substances abovementioned. An equal quantity of infusion of galls produces a precipitate which slowly subsides, it dissolves on heating the mixture, and again appears on cooling. The same appearance takes place if an equal quantity of water is added to the starch mucilage; and hence it appears to arise from the insolubility of starch in cold water. Alkohol precipitated it in the same manner as gum arabic.

Acetate of lead, and nitromuriate of tin, produce very copious

precipitations in paste made by boiling flour in water. Nitrate of quicksilver gave the paste a pink colour, and nitromuriate of gold a dusky gray, but no precipitate fell down; superacetate of lead, oxysulphate of iron, silicated potash, and infusion of galls, had no discernible effect.

Gluten of flour, digested for some days in water, seemed to be dissolved, and on the fluid being filtered, it continued rather opake. Acetate of lead, superacetate of lead, and nitromuriate of tin, caused a precipitation. Nitrate of quicksilver threw down a precipitate, and the liquor became of a pink-colour. Oxysulphate of iron yielded a precipitate, and nitromuriate of gold one of a light brown colour. Silicated potash produced no effect; but infusion of galls threw down a very copious precipitate.

As vegetable jelly procured from the pulp of the gooseberry could not be freed from acid, therefore it was not tried with the metallic salts, and silicated potash. Infusion of galls caused a precipitation.

Solution of sugar was affected by none of the above substances, except acetate of lead, which after some time rendered it opake; but the acetate is itself liable to this alteration on the addition of water alone, if exposed to the atmosphere.

Nitric acid produced, according to circumstances, from the mucilages either the saccharolactic acid, or a mixture of that acid and the oxalic.

Sulphuric acid, when concentrated, dissolves the different mucilages, and form a thick black fluid. Hermbstaedt has proposed this acid for the separation of gum from mucilage; but the coagulation he mentions could not be perceived.

Neutral salts did not produce any effects upon the mucilages; except that many of them coagulated quince seed mucilage.

The pure alkalies generally rendered the mucilages more fluid.

From the above experiments, an arrangement may be formed of vegetable mucilages; in which a due medium ought to be observed between the extremes of minuteness and too great laxity.

Genus 1. Gum.
Species 1. Gum-arabic, pure gum.
Genus 2. Mucilage.
Species 1. M. of linseed, or pure mucilage.
2. M. of quinceseed, coagulable by any acid, neutral, earthy, or metallic salt.
3. M. of hyacinth roots, which has obviously a quantity of starch mixed with it, and appears also to contain gluten.

Cherry-tree gum is perhaps a distinct principle, and might be denominated cerasin.

Tragacanth resembles starch and gluten, and more particularly starch which has been made into a mucilage with hot water, and then evaporated to dryness. In this state it is transparent, brittle, and almost insoluble in water. The effect of nitromuriate

of gold appears to depend upon a partial reduction of its oxide, at the same time it unites with the tragacanth. The effect was very evident when the mucilage contained $\frac{1}{50}$ of solid tragacanth; but if more dilute, it was not perceptible.

The same effect is produced, but in a slighter manner when nitromuriate of gold is added to flour paste.

Account of the Process of Distillation. By Mr. James Forbes.—*Rep. of Arts, &c.* No. 62, New Series.

This account is an abstract of the deposition of James Forbes, esq, of Dublin (who has been concerned for many years in a large distillery) before the Commissioners of Inquiry into the fees, gratuities, perquisites, and emoluments, received in the public offices in Ireland. It is abstracted from the appendix to their fifth report.

It was formerly the custom to use $\frac{1}{4}$ malt, and $\frac{3}{4}$ of a mixture of ground oats, barley, and oatmeal, but latterly no more corn has been added than was necessary to prevent the mash vat from setting.

Malt alone produces a greater quantity of spirit than a mixture of malt and raw corn.

The grain is first ground, and then mixed with water in the proportion of from 50 to 54 gallons of water to a barrel (168lb.) of corn. The whole of the grain is put into the vat, and each day's brewing is divided into three mashings, nearly equal. The two first, after being run off and cooled, are put into the fermenting backs, and a quantity of yeast added to them, to form wash. The third mashing, or "small worts," is run off late at night into the copper, to be used as water in the next day's brewing. The grain retains nearly its original bulk.

The mash vats are graduated, so as to shew, by inspection, what quantity of wort will come off. The strength of the wort is ascertained by Saunders' saccharometer; the mixture of the two first worts shewed an increase of 20 to 22lb. above water-proof, per barrel of 36 gallons of grain, at 88° Fahr. The small worts shewed only 6lb.

The wash is usually ready for the still in 24 hours after it is set, but it is generally contrived for the fermentation to be apparently kept up for the full time allowed by law, viz. 6 days. The backs being renewed either by a portion of wash from other backs in a less advanced state of fermentation, or when the fermentation is down, by an entire substitution of fresh worts.

The wash being distilled yields "singlings." A 500 gallon still is run off in from 20 to 23 minutes, one of 1000 gallons in 28 or 30 min. Some distillers now heat the wash nearly to boiling before they charge the still with it, by which means they save 3 or

4 minutes. The still is never charged more than $\frac{7}{8}$ of its contents, exclusive of the head. The estimated produce, is 1 gallon of singlings from 3 of wash.

The "singlings" being again distilled produce "spirits." When the singlings are put into the still, a small quantity of soap is added to prevent the still from running foul. A 1000 gallon still is worked off in from 40 to 50 minutes, and a 500 gallon still requires nearly the same time. The estimated produce of spirits is about 1 gallon from 3 of singlings; but it is freqently more. 20 gallons of feints or weak spirits is also usually run from a 500 gallon still charged with singlings. The still is never charged above $\frac{4}{5}$ of its contents. The spirits are usually about 14 per cent. above proof by Saunders' hydrometer. A desert spoonful of vitriol well mixed with oil is put into a puncheon of spirits when they are intended for home consumption, to make them shew a bead when reduced with water. For exportation a gallon of water is added to every 6 gallons of spirits, or they are drawn off from the still at that strength.

There is no delay between one charge and another; the still can be cleansed in less than a minute, and it very rarely happens that the ordinary accidents which happen to the still make any considerable delay, so that 6 charges of 150 gallons of spirits each may be run off, in a day, from a 500 gallon still.

Observation.—We have here a complete confirmation of its not being necessary to malt the whole of the grain used for brewing, in contradiction to the general assertion of writers on fermentation; but we apprehend there is no part of this deposition will attract so much attention from the generality of theoretical chemists as the quickness with which the distillation is conducted, so as to draw off the third part of the charge of a still of 1000 gallons in less than an hour.

Chemical Observations on making Red Wine, particularly when the Grapes are not quite ripe. By Mr. De Sampayo.—*Journ. de Phys.* May 1807.

Although it is well known that perfectly ripe grapes make the best wine, yet the weather frequently obliges farmers to gather their grapes earlier, and thus make a bad wine rather than run the hazard of having none at all. Macquer proposed to add sugar to the juice expressed from the unripe grapes, in order to supply the known deficiency of the saccharine principle; but there still remained the defect of a superabundance of malic acid.

The following process is the result of many years experience on an estate, the greatest part of which is not well adapted for the culture of the vine; by following which, red wines have been made equal to white, and which are not only able to be kept a single

summer, but have been sent from Lisbon to the Brazils, where they have acquired considerable reputation; whereas before it was adopted, although the white wine was strong and fit for keeping, the red was very acid and would not keep a single summer.

The grapes proper for white and red wine are as usual to be gathered separately, those for white wine are trod and pressed directly. The grapes for red wine are put carefully into the treading vat, so as to avoid breaking them as much as possible, and are there left for 2 or 3 days. They are then to be trod, and some heated juice of the white wine grapes added to them. This heated juice may even be poured on boiling, and in rainy seasons, it should be boiled for some time and scummed. This addition of hot juice must be repeated three or four times the first day, stirring the grapes each time. The next day a smaller quantity of juice, not so hot, is to be added. The third day in the morning, the head of the juice is seen to fall in the centre, and this shews the proper time to run off the must and press the remaining marc. The workmen employed gave the name of mellaçao (i. e. honeying) to this preparation of the red wine grapes.

The grapes ought not to be kept too long before they are trod, for fear of the acetous fermentation taking place. When very far from being ripe they may be kept for 4 days; but when nearly ripe even 3 days is too long.

It is impossible to prevent some of the grapes from being bruised in putting them into the treading vat, but no fermentation takes place in the small quantity of juice that exudes in consequence; if, however, this is apprehended, the juice may be drawn off, and will make the most excellent wine, as it will be the produce of the ripest grapes, and, of course, sufficiently coloured.

The skins of the grapes are greatly reduced by this process, so that the wine becomes higher coloured, than it used to do when it was left for 3 or 4 days in the treading vat, and the greatest part was boiled. The weak small wine obtained from the marc, shews that every thing of consequence is extracted from the grapes by this process.

The juice of white-wine grapes was added to the other, as the juice of red-wine grapes always smelled of vinegar when boiled. In farms where the white-wine grapes are rare, the juice of the others may be used, provided it be fresh pressed out from newly gathered grapes, and without any marc; that which came from them may be added in the treading vat.

772 grammes ($1\frac{3}{4}$ lb. av.) of the grapes called *negrier* at Paris, cut off very close, were divided into two portions. One of which was immediately squeezed and the juice filtered. The marc was first macerated in cold water, and then boiled in some more of that fluid. These liquors were evaporated to the consistence of a syrup, and the excess of acid removed by carbonate of lime. They were then treated with alkohol to separate the sugar, and the residuum treated

with boiling water and a little acetic acid, in order to take up all the malate of lime. It was then decomposed by acetate of lead, and the excess of acid separated by ammonia. As only a small quantity of acetic acid had been used, the tartarite of lime was not sensibly diminished. The solution made the alkohol contained the sugar, but as it could not be separated by precipitation, the solution was evaporated, and then treated with nitric acid, and muriate of lime, in order to convert the sugar into oxalic acid, and that into oxalate of lime. By this means there was obtained from this moiety of the grapes, 9.55 grammes of malate of lead, 4.04 gr. of tartarite of lime, and 41 gr. of oxalate of lime.

The other moiety of the grapes was kept for two days, and then examined in the same manner It yielded 3.77 grammes of malate of lead, 2.65 gr. of tartarite of lime, and 47 gr. of oxalate of lime. Hence, it appears that the malic acid, and perhaps the tartaric was partly converted into sugar by the grapes being kept thus long.

229 grammes of unripe grapes that had just began to become rather transparent, were divided and treated in the same manner. The moiety that was examined immediately yielded 4.35 grammes of malate of lead, 2.07 of tartarite of lime, and 0 27 of oxalate of lime. The other moiety was kept for four days, and then examined, it yielded 3.71 gr. of malate of lead, 1.48 of tartarite of lime, and 0.58 of oxalate of lime. The must of the first moiety was very difficult to filter, that of the second passed easily, whence it appears, that some part of the increased quantity of sugar arises from the mucilage in the grape.

Cold water does not extract the colouring matter from the marc of red grapes, but boiling water takes up a large proportion of it; which shews the propriety of adding heated must to the red grapes. The must of that portion of red grapes that had been kept some time was higher coloured than the other, and the marc gave a deeper colour to water whether cold or hot.

When must was treated with alkohol, there appeared a vegeto-animal substance, which formed lumps when the nitric acid was first applied, but afterwards dissolved in it. It is probably this matter that reacts upon the sugar, and converts it into alkohol.

Observations.—As grapes do not ripen well in this country, the information here given may be of some use to those who attempt to make wine. It has long, as Mr. Sampayo remarks, been the practice to sweat apples previous to pressing them for cyder, and therefore we are warranted to conclude, that the process may be extended to most fruits.

On making Starch. By Mr. James Graham.—*Phil. Mag.* No. 114.

In making starch from wheat, it is ground with a broader flag or bran than for flour. The meal is then completely wetted with water, in 3, 4, or 5 days it will ferment, and in a few

days more the fermentation ceases. The steeping is continued for 14 to 20 days, according to the weather; taking care not to be in too great a hurry to wash out the starch.

This washing out is performing by putting the fermented stuff into baskets supported over tubs, and keeping it constantly stirred while water is poured upon it, until the bran alone is left in the baskets.

The water that ran through, is strained through a hair sieve, and left for 24 hours to settle, it is then drawn off by plugs fixed at different heights in the vessel. A thin stuff called slimes floats above the starch which is taken off by a tray of a particular form, mixed with the bran (or grains) and used to feed hogs. Fresh water is then added to the starch, the whole strained through a fine silk sieve, and left again for 24 hours to settle; when this water is drawn off and the slimes taken off, the starch is again diffused through a fresh parcel of water, passed through the silk sieve, and left for some days, (4 or 5,) till the starch is very firm. The water is then drawn off, the slimes, if any, taken away, and the starch dug out and put into boxes six inches deep, bored full of holes, and lined with thin canvas, in which it remains to drain until it is a hard solid body.

The starch is taken from the boxes by turning them bottom uppermost, broken into pieces about 4 or 5 inches square, and set upon half burned bricks, until it is sufficiently dried to be put into a stove (resembling that of the sugar bakers.) It remains in the stove for some time, and on being taken out, the sides of the cakes are scraped, the starch is papered up and put again into the stove, until it be completely dry.

If Poland starch is be to made, 2 or 3lb. of the very best smalt is mixed with the starch the second time it is passed through the silk sieve, in order to give it the blue shade; unless the smalt is excellent the starch will not retain its colour in drying.

If the water is not mostly got rid of before the starch is put into the stove, it will dry into various hard substances called hamy, which will not melt when it comes to be used.

The slimes taken off after the starch has passed through the silk sieve, are not put into the hog-wash, but either mixed with some other starch, or again wrought up with water, and strained through the silk sieve; by which a considerable proportion will be converted into good starch.

Starch may be made from various other articles, particularly from potatoes; but the labour of grinding or grating is considerable. They are not fermented, for the operation of straining cannot be performed too quickly, as the starch settles almost immediately. The best potatoes yield only 4 or $4\frac{1}{2}$ stone of starch from 40 of potatoes. This starch is not saleable, not having so firm and long a grain as wheat starch, but it is preferable for blue-makers because it incorporates well with the colour.

NATURAL PHILOSOPHY, ARTS AND MANUFACTURES.

An Account of two Children born with Cataracts in their Eyes, to shew that their Sight was obscured in very different Degrees; with Experiments to determine the proportional Knowledge of Objects acquired by them, immediately after the Cataracts were removed. By EVERARD HOME, *Esq. F.R.S.—Phil. Trans. Part I.* 1807.

MR. Home's observations are intended to explain the apparent inconsistency of Mr. Ware's experiments, lately laid before the Royal Society, and those of Mr. Cheselden, which have long since been made public through the same channel; and he attributes the difference to the different state of the eyes before the observations. From the two cases which are here compared, Mr. Home concludes, "that, where the eye, before the cataract is removed, has only been capable of discerning light, without being able to distinguish colours, objects after removal will seem to touch the eye, and there will be no knowledge of their outline; which confirms the observations made by Mr. Cheselden; but "that where the eye has previously distinguished colours, there must also be an imperfect knowledge of distances, but not of outline, which however will afterwards be very soon acquired, as happened in Mr. Ware's cases."

The progress of the successive improvement in the faculty of seeing made by one of the subjects of these cases, a boy of seven years old, is related in a very interesting manner. The operation of couching was performed on the 6th of October, and gave very little pain. He had before been able to distinguish bright colours with tolerable accuracy; ten minutes after the operation, a round piece of card, of a yellow colour, was placed before his eye; he said immediately that it was yellow; and on being asked its shape, said, "let me touch it, and I will tell you." Being told that he must not touch it, after looking for some time, he said it was round. A square blue card, nearly of the same size, being put before him, he said it was blue and round. A triangular piece he also called round. He directed his eyes to objects at different distances, but seemed to see best at 6 or 7 inches. His focal distance has been since determined to be 7 inches. Being asked whether the object seemed to touch his eye, he said "no," but could not form any estimate of its distance. He was highly delighted with the pleasure of seeing, and said it was "so pretty," even when no particular object was before him. About two hours after the operation, as nothing could induce the child to abstain from the employment of his new sense, the experiments were repeated. At

first he again called all the cards round, but being asked if he could find any corners in the square card, he was very desirous of touching it; this being refused, he examined it for some time, and said at last that he had found a corner, and then counted the four corners of the square, and afterwards the corners of a triangle; but in doing so he directed his eye along the edge, naming each corner when he arrived at it. The next day a guinea being held at the distance of 15 inches from his eye, he said it was a seven shilling piece; but when placed about 5 inches from his eye, he knew it to be a guinea; and he made the same mistake as often as the experiment was repeated. Three days afterwards, he was allowed to go to a window, and immediately called out, "what is that moving;" being asked what he thought it was, he said, "a dog drawing a wheelbarrow; there is one, two, three dogs drawing another; how very pretty!" It may easily be imagined that these were carts and horses, which he saw from a two-pair-of-stairs window.

"In a practical view," says Mr. Home, "these cases confirm every thing that has been stated by Mr. Pott and Mr. Ware, in proof of cataracts in children being generally soft, and in favour of couching, as being the operation best adapted for removing them. They also led us to a conclusion of no small importance, which has not before been adverted to; that when the cataract has assumed a fluid form, the capsule, which is naturally a thin transparent membrane, has to resist the pressure of this fluid, which like every other diseased accumulation, is liable to increase, and distend it, and therefore the capsule is rendered thicker and more opaque in its substance, like the coats of encysted tumours in general. As such a change is liable to take place, the earlier the operation is performed, in all children who have cataracts completely formed, the greater is their chance of having distinct vision after the operation.

Observations.—The experiments of Cheselden, as well as the arguments of Locke, have tended materially to diminish the necessity of referring many of the functions of the senses to the dictates of instinct; and Mr. Home's judicious observations are also well calculated to elucidate the inquiry. Notwithstanding the success with which Locke has combated the prejudices of some earlier philosophers in favour of innate ideas, it must still be confessed that some of the moderns have endeavoured to extend the influence of experience much too far; and it seems impossible to maintain, with any appearance of probability, that all the complicated offices of the eye, are regulated by a habit derived from experience only, even when they depend on motions which are in some measure voluntary.

It may be inferred from Mr. Home's remark, that "*the focal distance*" of the eye after couching was "ascertained to be seven inches," that he is in some measure disposed to depart from his former opinion of the capability of persons, deprived of the crystalline ens, to see perfectly at a great variety of distances, As this boy ppears to be a very proper subject for the experiment, we hope Mr.

Home will not lose sight of him without endeavouring to throw some further light on this interesting inquiry.

Supplement to the Theory of Capillary Action. By Mr. LAPLACE.—4. Paris.

WE have been favoured, since the publication of our last number, with a sight of a copy of this work, which was announced by the author in December last as about to be published; and we think it necessary to give a short account of its contents, since some of the objections, which we made to Mr. Laplace's former memoirs on the same subject, are removed in it, while others still remain in their full force. By much the most interesting novelty that we find in it, is derived from the accurate experiments of Mr. Gay Lussac, on the ascent of water and alcohol in capillary tubes, and between two neighbouring plates, and on the adhesion of these fluids and of mercury to horizontal surfaces: the results of these experiments not only justify us in our remarks on those of Mr. Haüy, and on Mr. Laplace's application of them, but shew the error of Mr. Haüy to be, even greater than we had supposed; the mean height of ascent of water being found to be an inch in a tube of which the diameter is exactly .046, or about $\frac{1}{22}$ of an inch.

Our former doubts respecting "the integration of the equation" of the surface of a fluid, in a particular case, arose from the indistinct manner in which that case is stated. In fact it appears, although Mr. Laplace has not made the observation, that the curve is in this case the same as when the fluid is contained in a vessel of unlimited extent, and here the abscis may be determined by means of hyperbolical logarithms: for if u be the numerical chord of the inclination to the horizon, beginning from the vertex, and a the greatest height of the curve, the abscis will be $\frac{a}{4}\left(2u + h.\,1.\,\frac{2-u}{2+u}\right)$. This however has not hitherto been mentioned by those who have examined the nature of curves of this kind, although it may readily be deduced from the known properties of hyperbolical logarithms.

In almost every other investigation which Mr. Laplace has attempted in his Essay, we find a profusion of perplexed and intricate calculation, lavished, without necessity and without success, upon points which either do not require or do not admit its application. We should have given him great credit for labour and ingenuity if we had either only looked over this work, or merely studied it alone without further comparison with the facts on which it is apparently founded. But having made such a comparison, we must be permitted to say, not only that he has failed in his attempts to overcome the difficulties attending his calculations, but that he

must have known that he had failed, although he could not prevail on himself to lose an opportunity of dazzling the ignorant or careless with an ostentatious parade of sublime research. "This equation (s,) he says, "does not appear to be capable of integration by any known method; but I find that it may be solved" by a certain substitution: then, after several pages of obscure calculations, having obtained a formula for the depression of the surface of the mercury in the tube of a barometer, he proceeds to compare his theory with experiment. "I shall choose," he continues, "the experiments made by Lord Charles Cavendish, and related in the Philosophical Transactions for 1776. They give, in English inches, a depression of .005 in a tube of glass six tenths in diameter, .007 in a tube of half an inch, and .015 in a tube of four tenths. The foregoing formula gives in the first case a depression of .0038; in the second of .0069, and in the third of .0126; which *agrees* with the experiments, as well as can be expected from *observations* in which quantities so minute are to be ascertained. In our opinion such an *agreement* would be extremely unsatisfactory even if it extended to the whole of Lord Charles Cavendish's table: but let us take the next number in this table, or the next but one, which is a depression of 036 for a tube three tenths in diameter; here, Mr. Laplace's formula gives .021; for the last number, which is .140 for a tube of one tenth, the same expression gives .031; and for a tube of .015, in which the true depression is an inch, this refined mode of calculation, brings out .035, or a little more than one thirtieth of the truth. Can it be supposed that he would have stopped at the first three numbers, had he not found that in the rest, the error of *his own calculation* was too great to be attributed to the inaccuracy of the *observations* of another?

After such an example of Mr. Laplace's candour with respect to his own investigations, it is unnecessary to enquire in what manner he is disposed to appreciate those of other philosophers. Segner, he says, was aware that the idea of an equable tension of the surfaces of fluids "was only a fiction, proper for representing the phenomena, but which was only to be admitted so far as it was connected with the law of an extraction insensible at sensible distances: he endeavoured therefore to establish this connection." Surely it cannot be supposed that Segner would endeavour to *demonstrate* a proposition *mathematically* at the same time that he was persuaded that it was *only a friction*. "While I was employed on this subject," continues Mr. Laplace, "Dr. Thomas Young was also pursuing a similar inquiry; and his ingenious researches are inserted in the Philosophical Transactions for 1805. Comparing, as Segner had done, the force of capillary action to the tension of a surface supposed to envelope the liquid, and applying to this force the results of the known properties of such a surface, he found that it was necessary to consider its curvature in two directions perpendicular to each other. He has also supposed that these surfaces intersect the

sides of the tubes containing them in the same angle, whatever their figure may be, when the liquid remains the same, and the tubes are of the same substance; which, as we have seen, *is not correctly true* at the extremities of these sides. But he has not *attempted*, as Segner had done, to derive these hypotheses from the law of the attraction of the particles, decreasing with extreme rapidity; which was absolutely necessary in order to establish them. They could only be confirmed by a *rigorous demonstration*, similar to those which *we have given* in the first method, with which the explanations of Segner and Dr. Young are connected, as that of Jurin is with the second method."

These observations are so much in the same spirit with those which have already called forth our criticisms, that it is scarcely necessary to make any further general remark on them. We were at first so much at a loss to understand the nature of this exception to Dr. Young's law of a constant angle of contact, that we were oblige to turn back to the Essay for an explanation of it: It appears that the exception relates only to the case of the attachment of the surface of the liquid to an angular termination of the solid: but it is astonishing that Mr. Laplace should not have been aware that every physical angle is to be mathematically considered as a portion of an infinitely small cylinder, which may still be intersected in the given angle, notwithstanding a change in the position of the surface of the liquid; had he not been blinded by a desire to assert his own originality, he might have found in Dr. Young's remarks on the situation of a light body floating on mercury, an example which shews that this circumstance had not escaped his notice. That Dr. Young has not *attempted* to deduce a demonstration of the law of equable tension from the operation of an attractive force is certainly not true; and this force he supposes to operate only at a minute distance, which is a supposition perfectly equivalent to that of a rapid decrease of its intensity; how far either he or Mr. Laplace has completely *succeeded* in the attempt, we have already had occasion to inquire. We sincerely hope that some future opportunity will be afforded us of exhibiting Mr. Laplace's knowledge of the most refined part of the mathematics in a more favourable light; but we are afraid that it is possible to be a very great mathematician, and at the same time a very moderate philosopher.

Additional Remarks on the Capillary Actions of Fluids. By Aletes.—*Phil. Journ.* No. 79.

We have already given an account of the former remarks of this anonymous author: he here continues the subject with equal originality, and apparent accuracy. He confirms, by a mathematical demonstration, an observation of Mr. Laplace, that the capillary actions of different substances of the same kind must be proportional to the squares of their densities: he observes that the

same must be true of the capillary contraction of the surface interposed between two mediums which must be proportional not to the difference, but to the square of the difference of their densities. He finds, however, that although this principle ought to have been employed in his own demonstration of the law of the angle of contact of a solid and a liquid, which is nearly the same with Dr. Young's, yet, by a singular co-incidence, the result of that demonstration is not affected by the substitution. But he infers, both from reasoning, and from a direct experiment, that Mr. Laplace is mistaken in asserting that a capillary tube, containing two fluids, supports, by its attraction, the same weight above the general level, as if it were immersed in the denser fluid only.

From the same principle, he explains the mechanism of the well known fact of a drop of oil, spreading on the surface of water; deriving the immediate force concerned in its diffusion from the difference between the sum of the tensions of the upper and lower surface of the drop of oil, and the tension of the exposed surface of the water; whence he accounts for the circumstance of the oil not spreading on a surface which has already received a film from the diffusion of a former drop; and he observes that the horizontal situation of the general surface of the water must be and is in most cases a little disturbed by the presence of such drops floating in it.

Observations.—We shall only observe in general of this paper, that if the law laid down in it be fully established, it will constitute an additional step in our knowledge of the intimate actions of the ultimate particles of matter. The experiment mentioned by the author requires to be carefully repeated by different observers: but it appears to be in some measure confirmed by some of the experiments of Mr. Gay Lussac, related by Mr. Laplace in his last publication, of which we have given some account in the preceding article. Mr. Gay Lussac found that the capillary action, occasioning the depression of mercury covered with water in a given tube, was less than when it was covered with alcohol, which is evidently contrary to Mr. Laplace's theory. It is true that he appears to attempt to obviate this objection by considering the alcohol and the water as lining the tube of glass, and forming an interior tube which alone acts on the mercury: but before this explanation can be admitted, it ought to be shewn that the result of the experiment is different when these fluids are cautiously introduced upon the mercury, so as not to disturb its connexions with the glass.

On the Musical Temperament of Keyed-Instruments. By William Hawkes, *Esq.*—*Phil. Mag.* No. 112.

This communication was suggested by the perusal of some letters in the Monthly and Philosophical Magazines, relative to

the Stanhope and other temperaments. Mr. Hawkes thinks ord Stanhope's principle very ingenious, but not very successful; and says, he despairs of ever hearing tolerable harmony throughout the 24 keys of the present scale, conceiving it, indeed, to be impracticable, unless two scales, the one with flats, the other with sharps, be adopted. The method Mr. Hawkes chose in his publication on temperament, in 1805, was upon the principle of a specific division of the major tones of the scale, which must occasionally serve as minor tones, and is effected by subtracting one-fifth of a comma from a certain number of perfect fifths, in order to temper those tones which in every additional flat or sharp consequent to a new key require a tone a comma higher or lower; and to tune perfect, or in a small degree sharper, some of the fifths to meet such tones as are substitutes for real ones.

Speaking of Mr. Farey's observations on modulation Mr. Hawkes says that, since abrupt cadences are so frequent in modern music, it would be difficult to ascertain by any calculation what keys are more or less used; and of course their times of occurrence cannot be certainly known.

Mr. Hawkes is persuaded there are very little hopes of ever meliorating common keyed instruments, unless, as suggested in the former part of his paper one can be furnished with two scales, one with sharps and another with flats: but such an instrument may, he says, "be constructed without an additional key; *of which more hereafter.*"

Observations.—Mr. Hawkes's letter seems written more with a view of exciting curiosity than of satisfying those who have a thirst for knowledge. Indeed, we were in hopes when we saw this gentleman's name at the head of an article, that we should find much new and satisfactory information on a very interesting topic; but our hopes have been disappointed. Mr. Hawkes may be a very excellent theoretical and practical musician, or a very hospitable gentleman; but he is far, very far, from an elegant and perspicuous writer. We hope that when next he favours the public with another communication, he will not be confined either with regard to time or paper, but will, when he turns to the discussion of the most important and curious subject to which he adverts, pursue it *thoroughly*, and not vex his readers and injure his own character, by saying, as he now does, of this "*more hereafter.*"

Description of a Boat contrived so as to possess superior Staunchness and Strength. By Mr. J. W. Boswell.—*Rep. of Arts,* No. 62, New Series.

In the month of June 1803, Mr. Boswell had a boat constructed in the following manner. The frame was laid down in the method

usual for a carvel-built boat, only that greater spaces were allowed between the ribs. The stern pieces and apron were formed together of the same piece of timber; the stern boards were rabbetted together, and left unusually thick at the external edges (while the internal parts were dubbed thin with the adze) to admit of the ends of the planks being raebbtted also at the places of junction with these boards, as well as on the stern-piece, and in the stern-post; both the latter were likewise so scarphed to the keel as to leave a rabbet all round them at the joint, to prevent the leakage which often takes place at those parts.

A plank was laid over the whole length of the keel, and the ribs were let down so as to be flush or even with it. It projected about an inch at each side from the keel; the next planks at each side were joined to this outside, and close to the keel, so that its edges wrapped over them. These two first planks being fitted, before they were finally fastened on, narrow slips of about the same thickness as the plank, and about two inches broad, were let into the ribs their own thickness on both sides, at such a distance from the keel that when the first planks were laid on, they reached exactly to the middle of those slips: similar slips were in like manner let into the ribs all the way up to the gunnel, at regular intervals, corresponding to the breadth of each plank; so that the middle of each slip lay exactly over the seams of the two adjoining planks at the inside. The planks were secured to these slips by rivetting nails, in the usual manner for clinch building; but as the planks were all flush outside, and were joined edge to edge, as in a carvel-built boat, the seams admitted of being caulked in the same manner; while the slips, being close behind the seams inside, prevented the oakum from being driven through, by reason of the thinness of the planks, and at the same time secured more firmly what was driven into the seams by the gripe they had on that portion of the oakum which had passed the seams inside, and had turned up at right angles between the slips and the planks.

Observations.—Mr. Boswell has accompanied the preceding description of his structure of the boat, with an account of the public exhibition of the boat itself in London and other parts of the kingdom for a year and a half, in 1803 and 1804; and he has been thus particular, he says, because Mr. Wilson, of Richard-street, Commercial-road, has sent to the Society of Arts a model of a life-boat, the internal framing of which is precisely the same as this. Mr. W. having been rewarded with a medal for his invention, Mr. B. has taken these means to establish his claim to priority of invention in that part which relates to the framing. Mr. Boswell likewise affirms that Mr. Wilson has been anticipated in another part of his contrivance, viz. buoyant lockers, by Mr. Lionel Lukin in a patent taken out so long ago as 1785, the specification of which was published in the third volume of the first Series of the Repertory of Arts.

Description of a Thrashing Machine, recently invented in Perthshire. By P—N.—*Farm. Mag.* No. 32.

THIS implement is upon no very extensive scale, and is calculated for the use of small farmers. It is moved by water; and the cost is said not to exceed ten pounds. It consists of an upright axle, having scutchers fixed across near the top in the usual form, but instead of having any wheel at the bottom end, there are only a number of pieces of plate iron fixed on the circumference of the lower end of the axle, forming radii all round, which receive the impulse of the water through a trough. These are fastened by having one of their edges inserted in a groove, or mortise, cut about an inch deep into the axle, and by having a notch cut half an inch into both the upper and lower edges of the plate, flush with the circumference of the axle, so that a stout iron hoop being put on the axle below the plates, its edge fits into the notch on their under edge, and another hoop secures their upper edge in the same manner. The iron plates are about nine inches and a half long, besides the part put into the groove, eight inches and a half broad at the end near the axle, and nine and a half at their other extremity, which is bent up somewhat like the edge of a dripping pan to prevent the water from dashing over. The plates are eighteen in number, and are inclined at an angle of forty five degrees, being an equal angle between a perpendicular and horizontal plane; the water falling on them from a height of thirteen feet from an angle somewhat nearer a perpendicular. The diameter of the axle is thirteen or fourteen inches at the lower end, and tapers to about eight inches at the upper. No difficulty is expected to be found in adapting this invention to the drum and fluted rollers.

Observations.—The construction of this machine might have been given in a much plainer and less complicated manner, for the vertical axle is furnished with iron plates, precisely in the same manner as the axis of a kitchen smoke-jack is furnished with fliers, and the water-wheel of the thrashing machine receives its rotary motion by the fall of the water exactly in the same manner as the smoke-jack is whirled round by the impulse of the heated air. If by this method the motion of the water-wheel can be made regular, there does not remain a doubt but that the principle is applicable to any kind of thrashing, or other machinery, but it would seem that a fall of water of thirteen feet cannot be so accurately regulated, as to have its equability depended on. The common construction of overshot mills indicates that a shorter fall is absolutely necessary to ensure regularity.

Description of Lime-kilns, built in 1801. *By Brigadier General* DIROM, *of Mount Annan.—Transactions of the Highland Society,* Vol. 3.

"These kilns were constructed with a view to save fuel, to calcine the stone equally, and to give the burner the command of the heat." To accomplish these objects the two kilns were built circular, and adjoining each other, but instead of being open at the top, as the common lime-kiln is, they were covered with an arched dome, a door being left on one side at the springing of the arch, to put in the charge, and a chimney being carried out on the opposite side at the same height, to convey away the smoke. The walls were built in the usual manner with stone work and were lined with brick, an interval of about four inches being left between, which was filled with rubble and small stones without mortar; this was done to form a non-conductor of heat by admitting a circulation of air, in order to prevent the kiln from bursting by the expansion caused by the heat; and the whole was bound with frames of wood strongly fastened together at the distance of about six feet from the ground, and the same interval from each other. The charging doors were made circular and were shut by a frame of iron filled with fire-bricks, and hung on a hinge or bolt; the grate at the bottom was made with the four middle bars to draw out, the better to let down the calcined stone or lime-shells, when the kiln was choaked or did not draw freely: a damper was also put in the flue of the chimney to regulate the draught, and within the dome a flue was carried from each side of the charging door to the commencement of the chimney, to intercept the ascent of the smoke in some degree when the door was opened for charging. These kilns were not intended to be wrought by drawing and filling at the same time, as is done in common kilns; for then the advantage would be lost which arises from confining the heat in calcining the stone; but it was intended that one should be filled and kept shut, while the other was drawing, and so they were to be filled and drawn alternately.

It appeared to General Dirom that the current of air being regulated by means of the door below and the damper above, the burner may admit such a column, as might enable him to work the kiln as quickly as may be done, without waste of fuel and without melting or vitrifying the stone; or he may lengthen the process by lessening the draught of air through the kiln. As the expense of the kilns here described was about 300*l.* it is very justly observed that they can be recommended only where the demand for lime is considerable, and the saving of fuel an object of importance; the saving of this article not being more,

if so much, as one third part of what would be necessary in open kilns. And the writer is more cautious in recommending the plan to others, because though well satisfied that these kilns were constructed on sound principles, he has not resided long enough in the country to prove their effects by personal inspection, and the tenant, to whose care they were left, discontinued the use of them after two seasons.

Observations.—We have seldom witnessed a communication, in which the probable defects of the discovery are more ingenuously pointed out, than in this of Brigadier General Dirom. His kilns are certainly constructed on the purest mechanical and chemical principles, and if the effect fell short of his just expectations the cause ought rather to be attributed to the ill-management of the persons employed than to any defect in the kilns themselves. The value of lime calcined with a very great degree of heat is well known to all persons concerned in masonry, and every improvement of kilns, which increases the heat during calcination, may be considered an important discovery. It is to be feared that the great expense of building lime-kilns in the mode proposed will preclude the general adoption of the plan.

Description of a correct Chamber Barometer. By Mr. Gough.—*Phil. Journ.* No. 77.

Mr. Gough observes, that as good barometers cannot be procured from London without considerable risk, many intelligent persons in the country have been thereby prevented from entering upon a course of meteorological observations. He flatters himself he has removed this inconvenience by an easy and perhaps original method of correcting the imperfections of the instrument, and rendering it fit for the purpose of every meteorologist, whose pursuits and observations are confined to his parlour or his study. Mr. Morris of Kendal, who made a barometer for Mr. Gough on the principle he explains that fully answered his expectations, informed him, that an artist of moderate abilities might be instructed to make one of the same kind from a simple diagram properly explained.

Mr. Gough accordingly gives a diagram and an explanation of it. He makes use of a compound tube or inverted siphon as in a common barometer for containing the mercury with the bore of the longer leg equal to $\frac{1}{10}$ of an inch in diameter and that of the shorter to $\frac{12}{10}$ or $\frac{3}{4}$ of an inch. When it is filled he fixes it to a frame in a vertical position with the extremity of the longer leg sealed hermetically and that of the shorter one open. He also employs a scale of 3 inches, namely, from 28 to 31 properly devided and furnished with a nonius.

The following he assigns as the real cause of inaccuracy in the common weather-glass. If for the sake of illustration the surface of the mercury in the longer leg when the tube is first filled be supposed to stand at 29, 5 inches, and the line at which it stands at the same time in the shorter leg be marked, the instrument will give the true weight of the atmosphere in that instance, but in all others inaccurately. For when the length of the column of mercury in the longer branch of the siphon ascends above or descends below 29, 5 inches, in consequence of an increasing or decreasing pressure in the atmosphere, the surface of it in the shorter branch will descend below or ascend above the line, at which it stood in the same, when its surface was at 29, 5 inches in the longer one, which descent and ascent ought, he says, to be respectively added to and taken from the column in the longer branch. He therefore states a correction as necessary, and makes it by means of an ivory piston of a cylindrical form, about $1\frac{3}{4}$ inch in height and half an inch in diameter. Its lower extremity is a little convex, and immersed in the mercury. It is moved vertically by means of a stem or handle, which passes through a cap, that covers the mouth of the shorter tube, and has a hole in its centre wide enough to receive the handle. A bent spring is attached which keeps the piston in any position the observer chooses to assign to it. A necessary precaution to be attended to in the construction of the instrument is, that the dotted line marking horizontally the middle of the piston, should coincide with the line that marks the surface of the mercury in the shorter branch of the tube, when in the longer branch it stands at 29, 5 inches.

Observations.—Mr. Gough's method of correcting the common weather-glass seems to be both simple and ingenious, and at the same time well calculated for answering the purpose intended.

Example of a Calculation in the Doctrine of Chances. By a Correspondent.—Phil. Journ. No. 77.

This correspondent delivers nothing more on the subject of the doctrine of chances than a table of the chances of winning a raffle, carrying the number of the persons to throw from 1 to 30, and the number thrown from 20 to 48. To the table he annexes the two following remarks or directions.

To find the chance of losing, substract the chance of winning from 100. Thus having thrown 42, if there are five persons to throw, the chance of winning is 90, and that of losing 10, the odds being 9 to 1.

If the raffle is to be won by the lowest number, the chance may

be found by subtracting the number thrown from 63, and consulting the table.

Observations.—The author has not given the calculations, on which he grounded, or from which he framed this table; we cannot therefore determine whether it is strictly correct

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Questions on some Appearances of the Electric Spark.—By a Correspondent.—Phil. Journ. No. 77.

These questions relate to various appearances of the electric spark. The writer asserts, that when an electric spark is taken from the conductor of a machine, the line of white light is interrupted, and that the spark becomes red, assuming sometimes the form of two cones, one proceeding from the conductor, and the other from the body, that is applied to it. He also states, that at other times, the interruption is next to the conductor, and on other occasions, it is perceived nearest to the body receiving the spark; that when the spark is taken at the least distance possible, the light is sometimes red and sometimes white; and that when the spark is some inches in length, the interruption is perceived in two or three places of the line of white light. He wishes to be informed if these appearances have been remarked, and asks for an explanation of them.

Observations.—The accuracy of this statement appears to us somewhat questionable, from the phenomena being various and opposite at different times. The smallest degree of inaccuracy in the observer, might lead to a misrepresentation, or mistatement of the appearances. Besides, the questions respecting them, are too vague and undeterminate to admit of precise and definite answers.

Observations and Measurements of the Planet Vesta. By John Jerome Schroeter, F.R.S.—Phil. Tran. 1807. Part. 2.

Mr. Schroeter made his first observations on this planet with magnifying powers of 150 and 300, applied to an excellent 15 feet reflector, and found it look as a point exactly like a fixed star of the sixth magnitude, with an intense radiating light, but *without any appearance of a disc.* In the same manner he and those who were present with him in making the observations, saw it several times afterwards with their naked eyes when the sky was clear, and when it was surrounded by smaller invisible stars, which rendered it impossible to be mistaken for another.

He says, that as the observations and measurements of Ceres,

Pallas, and Juno, had been made with the same eye-glasses, but with a 13 feet reflector, they soon after viewed this planet with glasses of 136 and 288 times magnifying powers in the same reflector, and that in it, as well as in the fifteen feet reflector, it had the same appearance, its image being that of a fixed star of the sixth magnitude with an intense radiating light.

At 9 o'clock true time in the evening of the 20th of April, he succeeded in effecting the measurement of Vesta, with the same power of 288, by means of the 13 feet reflector, with which that of Ceres, of Pallas, and of Juno had been made. Of several illuminated discs of 2,0 to 0,5 decimal lines, which he had before used for measuring the satellites of Jupiter and Saturn, he found that only the smallest disc of 0,5 lines could be used for the purpose; and that its rounded nucleus, when the disc was at the distance of 611,0 lines from the eye, was at the very utmost hardly equal to it. He therefore estimated it at one sixth part less, making the *apparent diameter* of this planet, only about 0,488 seconds, and of course only half that *of the fourth satellite of Saturn.*

He observes, that the extraordinary smallness of this planet, with such an intense radiant, and unsteady light of a fixed star, is the more remarkable, as by the preliminary calculation of Dr. Gauss, there can be no doubt of its being in the same region between Mars and Jupiter, in which Ceres, Pallas and Juno, perform their revolutions round the sun.

Observations.—This paper is written in the simplicity of truth, and with every appearance of modesty and candour. It savours not in the smallest degree of self-sufficiency, or dogmatical conceit. The author does not assert, that he effected an exact measurement of the planet Vesta but candidly acknowledges, that the smallest disc of 0,5 lines was too great for it. He supposed its diameter might be less by about one sixth, and on this estimation calculated its apparent diameter at 0,488 seconds, without advancing as an absolute certainty that this is the real measure of it.

Observations on the Nature of the new Celestial Body, discovered by Dr. Olbers, and of the Comet which was expected to appear last January in its return from the Sun. By WILLIAM HERSCHELL, *LL.D. F.R.S.—Phil. Trans.* 1807, Part 2.

IN this paper, Dr. Herschel informs us, that the discovery of an additional body belonging to the solar System by Dr. Olbers, and by him called the planet Vesta, was communicated to him on the 20th of April, 1807, but that the brightness of the moon, which was near the full, and at no great distance from the quarter, where from the information he had received of its motion, he was led to

look for it, would not permit a star of even the fifth magnitude to be then seen, or a tolerable view of that part of the heavens, in which it moved, to be obtained till the 24th. He tells us, that he then made several delineations of certain telescopic constellations, and fixed on a star, most likely from its expected situation and brightness to be the one for which he was looking, that in examining his delineations of the preceding evening, on the 25th he found no material difference in the situation of the stars he had marked; that in addition to them, new asterisms were prepared, but, on account of the retarded motion of the new star, which was approaching its retrogradation, the small change of its situation was not sufficiently marked to be easily perceived the following day, when these asterisms were again examined; that a long interruption of bad weather prevented him from examining regularly the situations of small stars; and that it was only in consequence of information he obtained from the Astronomer Royal, who was already in possession of its place and rate of motion, that he was enabled to direct his telescope towards it, by an application of high magnifying powers. He states his observations on it to be the following.

On the 24th of April, a magnifier of 460 did not shew it to be different from the stars of an equal apparent brightness, whence he concluded that its diameter must be extremely small, and that it may reasonably be supposed an *asteroid*.

On the 21st of May, with a double eye-piece, magnifying only 75 times, this supposed *asteroid* made a right-angled triangle with two small stars. And with a very distinct magnifier of 460, it had no appearance of any planetary disk.

On the 22d of May this star or supposed asteroid no longer formed a right angle with the same stars as before, but had moved away from them, and formed an obtuse angle with them. As the air was remarkably clear, he saw it very distinctly with magnifying powers of 460, 577, and 636, but could not observe any difference in the visible size of its disk and those of stars of the 7th magnitude.

On the 23d of May this star had still advanced, its motion being then direct. Its apparent disk, with a magnifier of 460, was then about 5 or 6 tenths of a second, but this was evidently a spurious appearance, as higher powers destroy the proportion it bears to a real disk when equally magnified; and the air that evening was not sufficiently pure for using large telescopes.

On the 24th of May, with a magnifying power of 577, he compared the appearance of the Georgian planet to that of this *asteroid*, and with this power the diameter of the visible disk of the latter appeared to be about $\frac{1}{5}$ or $\frac{1}{10}$ of the former.

From these observations he draws this result, that we are now in possession of a formerly unknown species of celestial bodies

which by their smallness and considerable deviation from the path in which the planets move, are in no danger of disturbing or being disturbed by them.

As to the telescopic comet, which he says was expected to be seen on its return from the perihelion about the middle of Jan. near the southern parts of the constellation of the whale, he tells us, that on the 27th of that month, he gave the place where it might be looked for to his sister Carolina, who the same evening about 6 *h*. 49′ saw it between flying clouds just long enough to make a short sketch of its situation.

On the 31st he obtained a transitory view of it within a few degrees of the place, which had been assigned to it, but the unfavourable state of the atmosphere prevented him from using any instrument proper for examining it minutely.

On the 1st of February he used a ten feet reflector with a low power to examine it; then there was no visible nucleus, and the light, which is called the coma did not increase suddenly towards the centre, but was of an irregular round form, extending with that low power to about 5, 6 or 7 minutes in diameter; with a magnifier of 169 it was considerably reduced in size, which plainly indicated, that an increase of magnifying power would be of no use for discovering a nucleus; and on account of cloudy weather he never saw it afterwards.

By comparing these observations with his former ones of 15 other telescopic comets, he found that out of the 16, which he had examined, 14 had been without any visible solid body in their centre, and that the other two had a very ill-defined central light, which might perhaps be called a nucleus, but did not deserve the name of a disk.

Observations.—The remarks of Dr. Herschel on the planet Vesta lead to no satisfactory result whatever. It appears indeed even from his own account, that he would not have observed it at all but for the information respecting its place and rate of motion which he received from Dr. Maskelyne. He calls it as well as Ceres, Pallas, and Juno, asteroids, although they belong to the solar system and revolve round the sun, merely from the circumstance of their resembling small fixed stars in brightness. There seems to be however an absurdity, or at least a very great impropriety, in calling small planets the images of stars. The word *asteroid* is derived from ἀστηρ, star, and εἰδος, form, image, or appearance. And if the revolving of these small planets round the sun, and their forming a part of the solar system, are to be regarded as trifling considerations in fixing on a name for them, and nothing is to be attended to but the mere circumstance of their being similar to apparently small stars in point of radiancy and brightness, why not give them the appellation of astereids, which

points out the derivation of the term much more distinctly than the word asteroids does. But either of them must be considered as highly improper. The Doctor's observation, "that these bodies by their smallness and considerable deviation from the path in which the planets move, are in no danger of disturbing or being disturbed by them" is neither satisfactory nor consistent with itself. For though the minuteness of these small planets may be a good reason for their not disturbing the larger bodies in the system, it may certainly be adduced as an equally good one on the other hand for their being disturbed or acted sensibly on by them. We know, that the Doctor once sported an opinion, that thirty thousand of Ceres would hardly make a body as large as Mercury, in which however he was egregiously mistaken. But he is too precipitate and adventurous on most subjects, and seems frequently to carry too much sail for his ballast.

The two small stars referred to in this paper as marked a, b, in figures 2, 3, and 4, are not to be found in them, but we met with asterisms marked fig. 9.

The Doctor and sister Carolina's observations of the expected comet in January last year amount to nothing; they serve only to inform the public, that each of them had an unsatisfactory peep at it.

Observations on Mr. Schmalcalder's Patent for a Machine for tracing and cutting Profiles. By Mr. J. J. Hawkins.—*Rep. of Arts,* No. 60, New Series.

The object of the writer of these observations is to prove that all which is valuable in Mr. Schmalcalder's alledged invention (*Repertory of Arts,* No. 57, New Series, *or Retrospect,* No. 8), is described in Mr. Hawkins's specification (*Rep. of Arts,* No. 23, New Series). This is a point which we think he establishes completely, both by the circumstances related, and by parallel extracts from both specifications. It hence follows that Mr. Hawkins's patent is infringed, by the subsequent one of Mr. Schmalcalder; and therefore that those who use machines constructed by the latter, will be liable to a prosecution from Mr. Farthing of Cheapside, who has purchased the patent-right of the former.

Description of a machine for Triturating, and Combining, Quicksilver with other Substances. Phil. Journ. No. 71.

This apparatus is formed by a pallet, or triturating instrument, made to move backward and forwards in a longitudinal trough, against the bottom of which it is caused to press with some force.

The bottom of the trough is about two feet long and four inches wide, and is made of cast iron, curved so as to form a segment of a circle of four feet radius; the sides and ends of the trough are formed of plates of iron about four inches broad, and are secured to the bottom by screws. It stands on legs of that height which is most convenient to the person who is to prepare the mercury.

The pallet, or triturating instrument, is made of iron, and is so constructed as to fit the trough transversely with accuracy; it is about three inches thick, and is rounded at the bottom; a bar rises from it vertically about four feet in length, and is jointed at top by a pivot to an horizontal bar placed lengthways over the trough, one end of which is fastened by an hinge to an upright fixed frame, and its other extremity sustains a weight, whose pressure presses down the pallet against the bottom of the trough.

The pallet is made to move backward and forward by a moveable horizontal rod, which proceeds from about the middle of its vertical handle to a crank whose axis is sustained horizontally across the direction of the trough at a convenient distance from one end of it by the upright fixed frame before mentioned.

The crank is turned round by a winch, and has a vertical fly wheel annexed to it to regulate its motion; the place where the horizontal rod is attached to the handle of the pallet should be at a distance from the centre of motion, so proportioned to the throw of the crank that at every revolution of the fly-wheel the pallet must move backward and forward the whole length of the trough.

A cover is fitted to the trough with a longitudinal aperture in it, just wide enough to let the handle of the pallet pass along it.

The mercury and the substance intended to be mixed with it are to be put into the trough, in equal proportions at each side of the pallet; and then, by turning round the winch, the whole will soon be completely blended together.

The anonymous Inventor of this apparatus observes, that it is well calculated for mixing mercury with compositions of sufficient tenacity to form plasters; which before could only be done by mingling the mercury with sulphur, or with other matters which have a chemical action on it that in most cases diminish its efficacy.

He also mentions that it may be made of any size required, and may be applied to various other useful purposes; among which that of preparing colours for painters is the most obvious; but for this purpose the bottom of the trough and the pallet should be made of porphyry, or some other hard stone.

A Machine for splitting Sheep Skins, invented by Mr, Benjamin Stott.—*Trans. Soc. Arts*, Vol. 24.

Mr Stott's object in this machine was to cut off that part of ship skins in an entire surface, so as to be applied to more useful purposes, which commonly is only shaved off in small pieces, and used solely for making glue.

The machine consists of a barrel of cast iron with wooden ends, of a diameter sufficient to contain a whole skin in its circumference without lapping. The barrel has a longitudinal groove cast in its surface. It lies in a horizontal position, and turns on an axis, the ends of which rest on friction rollers rising from slips of brass which are moveable under screws, passed through nuts in them, by which the barrel can be adjusted to the cutting knife.

To support this cutting knife a bar of wood rests upon the front of the roller, on friction rollers, which admit of its moving in the direction of the roller close to it, across the frame with an alternately reversed motion; the knife is screwed to the front of this bar with its edge extending below the bar and pointing downwards, so as form a tangent with the surface of the roller; underneath the knife bar, and behind the knife, a small roller is placed horizontally, whose gudgeons move in two sliding pieces, that being drawn forward by weights hanging over pullies, keeps it always close to the back of the knife; over this small roller, the upper portion of the skin is drawn off, as it is cut from the other part, which keeps both sides of the skin equally up to the knife, and makes the latter cut more uniformly.

The knife is moved from side to side alternately by two levers connected in succession, one over the other; the centre of motion of the first lever is so placed, that it acts on the extremity of the second with about four times the power of the mover; that of the second being placed nearly in its middle it serves only to reverse the direction of the first; its other end passes between two pins in the knife bar, and gives it motion. The use of this disposition of the levers is that it admits the mover to stand close to the frame while he uses a lever of such a length, that if it were applied singly to the knife, would oblige him to stand at too great a distance from the work: a rest is placed in front to support the handle of the lever. The barrel is moved round to the knife by a cord that laps about it, which passing thence over a pulley, has a weight appended to its other extremity.

The skin is secured to the barrel by a small iron bar with pins projecting from it, that press it into the groove of the barrel beforementioned, and is made fast to the sides of the barrel by hooks; the sides of the skin are also drawn over the extremities of the barrel, and fastened to its wooden ends by pins or nails.

A strong wooden frame supports the whole apparatus, which as it has nothing peculiar in it need not be described.

The Society for Arts, &c. voted Mr. Stott, twenty Guineas for this splitting machine.

Observations.—A Machine for splitting skins is by no means a new invention. The Dublin Society had one in their repository many years ago, and probably it is there still: it was however considerably more complicated than this of Mr. Stott.

It does not appear that the friction rollers directed for this ma-

chine, are of any great utility, as there is no great weight or pressure to be applied either to the barrel, or the knife, and as the machine will be simpler without them probably they had better be omitted. It seems also that the quadrupled power given by the lever is unnecessary, when there is nothing to be moved that requires any considerable force, or indeed any force greater than what a man could easily supply with one hand without any lever. It may, however, make the motion steadier than what could be given by the hand applied more immediately to the knife-bar.

Remarks on the Structure of Covered Ways independent of the Principle of the Arch in equilibrium, and on the best forms for Arches in Buildings. By Apsophus.—*Phil. Journ.* No. 79.

Apsophus asserts, that the subterraneous passages or tunnels of the Babylonians were, according to the opinion of the best informed antiquaries, formed by simply making the bricks or stones of each of the side walls project gradually as they rose higher till they met in the summit, or were each of them as to its section in the form of a triangle with a rectilinear base, and both the other two sides indented. He supposes the cloacæ of the Romans to have been constructed in the same manner, and observes, that the pointed arches of the Gothic buildings are by no means universally so arranged, as to derive their stability from their curvaures being every where proportional to the pressure that would be produced according to the theory commonly received, by the height of the superincumbent wall. He seems to think, that the subject has not been mathematically investigated in all its parts, and therefore submits to the consideration of his readers some propositions relative to the stability of overhanging walls and of triangular covered ways. For the purpose of explaining and illustrating these propositions, he makes use of 21 figures or diagrams, but examines those cases only, in which the materials employed are equal rectangular parallelopipeds; and in the first place supposes them to be destitute of all friction or adhesion, and to be placed horizontally.

In this case he shews that a covered way, not exceeding in breadth thrice or four times the length of a brick or stone, may easily be made, that will stand in equilibrio without external support; and that if the width of the covered way be equal only to twice the length of the brick or stone, any height of wall may be placed over it without destroying the equilibrium. He allows however such combinations of the materials to be incapable of resisting the pressure of any considerable force, and does not consider this method of building as generally adviseable. But by extending the bases and heightening the wall at the sides, he says, a much greater degree of strength might be obtained. He observes, that

a wall terminated in this manner, would by no means necessarily exert such a degree of pressure on any stones forming a facing of the oblique surface, as is commonly supposed in the theory of arches; but that on the contrary, an arch might be turned under it, which would be sufficiently strong for every purpose, if only capable of supporting little more than its own weight, and that this reasoning is applicable to the wall in contact with the lower parts of every common arch; whence he draws the inference, that it is eligible to construct the arch in such a manner as to render it more capable of resisting a pressure near its vertex, and of course making its form approach in some degree to that of a pointed one.

Apsophus then proceeds to enquire into the conditions requisite for the stability of an oblique facing, composed of rectangular bricks, or stones only, both with and without the consideration of the effects of friction. In the first place he considers a facing of one brick, or the case of two bricks meeting each other at the top, and standing on a perfectly smooth and horizontal plane, which is the simplest of all. He calls the angle, at which by inclining their surfaces to the horizon they begin to slide on each other, the angle of repose.

The case of a facing of two blocks on each side, is next considered, and it is shewn that when the friction is barely sufficient to retain them, it is to the oblique resistance of 1 to 5, and to the pressure, nearly as 10 to 47; that whenever the friction is greater than in this proportion, as it almost always is, in the materials commonly employed, two pairs of equal blocks will be secure against sliding, in every possible position; that the friction of common bricks or stones, is equal to half the pressure; and that 18 bricks might stand on each side at an angle of 60.

Two modes are then adverted to, in which such a structure might give way, and the following observations on arches in general are introduced.

1st. That the objects to be attended to in the construction of an arch, are to diminish the horizontal thrust as much as possible, and to secure its stability by such an arrangement as requires the least size in the blocks and firmness in the joints.

2d. That the size of the blocks should be such as to make the curve of equilibrium under the pressure actually produced by the walls, be included every where within their substance without even coming very near their termination; and that the horizontal thrust will, *ceteris paribus*, be less as the arch is higher.

3d. That if the height of the wall supported by the arch be very considerable in proportion to that of the arch itself, the curve of equilibrium will be nearly a parabola, and if the wall be raised but little above the arch, the said curve will approach to a segment of a circle.

4th. That a segment of a circle is a preferable form for an arch to that of an ellipse, as its horizontal thrust is less, though it be not quite so pleasing to the eye.

5th. That a Gothic or pointed arch is better than a Saxon or semicircular one, when its height is greater.

6th. That with the same height, an arch composed of two parabolic segments meeting in the vertex, is stronger than a semicircular arch.

7th. When the arch is flatter than a semicircle, an arch of a segment of a circle is somewhat stronger than a pointed one composed of either parabolic or elliptic arch ; but that when the arch is higher than a semicircle, a single circular arc becomes inapplicable in practice, and it is then of little consequence whether the two arcs composing the arch be circular or parabolic.

Observations.—We must acknowledge that in the remarks of Apsophus on this subject there is manifested a considerable degree both of ingenuity and originality : He examines and illustrates the cases he takes into consideration with satisfactory minuteness ; and we must own, that we see no good reasons, after scrutinizing his positions and arguments, for inducing us to refuse our assent to his inferences or conclusions, which we are inclined to think will prove very useful in practice.

Report of a Committee of the House of Commons, appointed to take into consideration an Act of James the First, concerning Tanners, Curriers, Shoemakers, and other Artificers occupying the Cutting of Leather.—Rep. of Arts. No. 67, New Series.

This act of the 2d of James the First, constitutes the present code of regulations for the internal leather trade.

The committee are of opinion that the prohibition of tanners being at the same time curriers or cordwainers, is detrimental to those in less populous districts, but they are afraid that the repeal of it might endanger the collection of the excise duties on leather. The late re-enactment, that no tanner should be a butcher, they consider as an oversight of the legislature, as the original grounds of this prohibition no longer exist.

The restrictions on the purchase of the raw material they think ought to be suspended, as contrary to every principle of sound policy.

That oak trees for bark should not be felled but between the 1st of April and the last of June, is conceived by the tanners themselves to be unimportant.

That no person shall engross or regrate oak bark, is totally contrary to the true principles of commercial regulations ; and the fears of the tanners would be removed, if they were at liberty to make use of whatever ingredients they conceive to be best adapted to their purposes. That this might be safely done is evident, as it is admitted even by the artificers themselves, that a careful exa-

mination will always shew whether leather is well and properly tanned.

The use of several ingredients is forbid by the above act, although vitriolic acid is indispensably necessary for the preparation of butt leather, and the bark of willow, birch and elm might be substituted for that of oak. Terra Japonica is also found to tan leather as well as oak bark, except as to colour, and although quercitron bark is weaker than that of oak, yet another American bark which did not answer in dyeing has been found serviceable.

Leather cannot be made dry at all times, according to the legal method; but the use of fire or summer sun might be allowed, as any injury from an improper use of them would be evident to the most unskilful purchaser. And if the length of time directed by the act was rigidly observed, some kinds of leather, and some parts of the hide would be injured and rendered useless.

The act orders the appointment of sealers and searchers of leather, who are to seize all leather not properly tanned and dried. This regulation is become obsolete, except in a few places, and the seizure has only been enforced in Leadenhall market since 1790. Many abuses and improper customs prevail in that market, both on the part of the City, and the searchers themselves. With respect to the dryness of the leather in the market it is of no importance to the consumer, as the artificer is, for the most part, under the necessity of moistening it again. The purchasers indeed cannot generally ascertain within less than 2 per cent. what extraordinary weight leather may have received from moisture, but they are in general better judges than the searchers, and seldom rely upon the seal; to which may be added, that leather packed in a wet condition would be liable to injury, which would be detrimental to its sale. But on the other hand, the curriers say, that before the enforcement of the act they found it difficult to procure dry leather; and they have not the same conveniency in town for drying it, as are possessed by the tanners in the country.

The clauses of the act which direct in what manner leather should be curried, and in what manner wares shall be wrought of leather, are vexatious and absurd, as the consumer is not liable to imposition in that respect.

It is only adviseable for the sake of upholding the reputation of our export trade to continue a penalty upon leather not sufficiently tanned; and perhaps upon boots and shoes made of sheep skin, which are deceitful articles, and not easily distinguished by the purchaser.

Observations.—Great improvements in tanning are expected from the researches which Chemists have lately instituted concerning the materials used in that business. The quantity of the tanning principle that has boen discovered in catechu (or Japan earth, as it is erroneously denominated) immediately suggested its use in tanning, although it is expressly prohibited by the statute

of 2 James I, as mentioned in the above abridgement of the report of the Committee appointed by the House of Commons to examine laws relating to the leather manufactory. It would appear from this prohibition that it was even then used by some persons concerned in the tanning trade.

The general nature of the processes that have been proposed for saving time in tanning, has been the employment of infusions of materials that contain a greater proportion of the tanning principle than oak-bark does. It has long, however, been found that these strong ouzes harden the leather, and render it brittle, by reason of the absence of that due proportion of the extractive principle of vegetables, which is essential to the formation of good mellow leather.

Improvements in Printing Paper-hangings. By Mr. JOHN MIDDLETON.—*Trans. Soc. of Arts, Vol* 24.

MR. Middleton's contrivances are intended to facilitate the conveyance of the paper over the printing-table, and to give a greater pressure than usual to the block, when printing dark grounds.

To facilitate the conveyance of the paper, two cords 36 feet long are stretched from the printers table to the other end of the room through rings, where they are kept tight by a weight appended to their extremities. The paper to be printed is rolled up on a wooden roller at one side of the table, and its ends brought across the table and fastened between two flat ledges that are connected at one end by an hinge, and at the other by a sliding ring; these ledges slide along the two cords on pullies placed at each end of them, and serve to draw forward the paper as it is printed; from the middle of these ledges a cord proceeds to the end of the room, between the other two cords where it passes over a pulley, and thence returns to a roller under the table; the circle of this roller extends beyond the table, and there has a wheel fastened to it, from which projects three pins, each about four inches long, by pressing on which with the foot the wheel is turned round, and with it the roller; by means of which the paper is drawn forward on the cords a space corresponding to the distance between the pins in the wheel.

The contrivance for giving an extraordinary pressure to the block, consists of a long and a short lever projecting from one side of an axle placed over head above the printers table, which levers and the matters supported by them are balanced by a weight appended to an arm which proceeds from the other side of the axle; from the long lever a cord falls to the ground where a treadle is attached to it: a long pole is jointed to the end of the short lever, and descends from it directly over the place of the block, on which it is made to press by standing on the treadle whenever it is thought proper, and is put out of the way when not wanted, by placing the end of it behind a piece of wood which projects upwards from the back of the table for that purpose.

REVIEW OF SPECIFICATIONS OF PATENTS.

PUBLISHED IN THE REPERTORY OF ARTS.

Mr. APSLEY PELLATT'S *Patent for admitting Light into the internal Parts of Ships, Vessels, Buildings, and other Places —Dated July* 1807.—*Rep. of Arts*, No. 65, New Series.

THIS method consists in placing a plano-convex lens in a suitable aperture, in order to serve as a window or a skylight.

The convex side is placed next to the light, and the plane side on the inside of the room. Both sides may be polished, but where any danger is to be apprehended from the lens acting as a burning glass, one side at least should be ground or roughed. The size may be varied according to circumstances, in general, they ought to be about 5 inches diameter, and $\frac{1}{2}$ inch high in the centre; and they may be fixed in a wood, or metal frame, with putty, or other cement.

When used on the decks of ships, it must be made sufficiently strong to resist the weight of goods, or the beating of the waves, by its thickness on the edges being increased.

The convex part must project above the deck or side of the building; the passage of men, or goods over the lens will not prevent the effect, and of course it may be used in every situation, except where it may be liable to injury from the passing or repassing of horses, &c.

The under part of the deck, or the inner part of the place where the "*illuminator*" is placed, must be sloped all round, that the rays of light may diverge in all directions.

These lenses may be advantageously employed, in the lanthorns for lighting the powder magazines of ships.

Observations.—We have no doubt but that this mode of illuminating rooms or other places may be highly advantageous in situations where local circumstances prevent the formation of an aperture of sufficient size for the application of an ordinary window, as the projecting lens will undoubtedly occasion the intromission of more light than could otherwise be obtained.

Mr JOHN LAMBE'S *Patent for a Machine for extracting fresh Water from the Salt Water of the Ocean (by Distillation), and other Purposes, at Sea and elsewhere. Dated July*, 1806.—*Rep. of Arts*, No. 66, New Series.

As this specification is not accompanied with a drawing, several parts of it are rather obscure. The front range is to be made in one

or two parts, and dampers or doors made over it so as to close and shut up the front. The oven is to be about the length of the range, and may if required be made in two parts with a door at each end.

Two dampers, to fall occasionally on to the top of the oven, so as to make the whole front fire draw under, and communicate with the boilers, are placed in the back part of the hearth. By raising one of these dampers at a time, the heat may be communicated either to a single boiler, or two or more. When no fire is required in the front, the dampers are to be down, and the fuel introduced directly under the boilers.

By drawing out a horizontal damper to be made in the back of the stove, the fire may be drawn under the distilling boiler, so as to cause it to boil by the heat that would otherwise be lost by going out at the flue.

The distilling boiler, to have two covers, one moveable to shut down steamtight; the other permanent with a stillhead, communicating with a worm fixed in a refrigeratory filled with cold sea water.

On the top of one or more of the cooking boilers are also to be fitted moveable covers, and also still heads, communicating with a separate worm, fixed however in the same refrigeratory.

In the centre of the moveable covers of the cooking boilers, there is to be fitted steam kettles for cooking by steam, if necessary.

In the cover of the refrigeratory itself, a steam kettle may be fixed; the steam to be let into this kettle by a pipe fitted to one of the cooking boilers, and to pass out into the same worm.

A hand-pump may be fitted into the refrigeratory, to draw out the water when it becomes hot.

Observations.—The distilling part of this apparatus has been long known, and applied to the purpose of procuring fresh water at sea, even so early as the reign of Elizabeth. The direction of the heat produced in the range to the heating of the boilers must be liable to so many inconveniences, as to far outweigh the saving of fuel.

Mr. Robert Bowman's *Patent for making Hats, Caps, Bonnets, &c. of Whalebone. Dated October*, 1807.—*Repertory of Arts*, No. 66, New Series.

This method consists principally in making the whalebone soft and flexible by means of heat, either by exposing it to steam, or a dry heat, or by immerging it in boiling water, or any other way that may occur to the workman.

To form hats, caps, &c. the whalebone is to be cut while soft, into proper breadths, that one may answer for the crown, another

for the sides, and one or more pieces for the brim. These pieces are fitted while warm upon a heated block, and joined together, either by sewing, or by being cemented with isinglass dissolved in alkohol, or any other cement, or by being soldered together like tortoiseshell, by having the edges fresh rasped, placing some of the raspings between the joints, applying a hot iron on each side of the joint so as to cause the raspings to melt, and soldering the two edges together. When cold the work may be polished and finished with sand paper, powdered charcoal, burnt cork, &c. and afterwards varnished with copal, or any other elastic varnish.

The whalebone may also be cut, while soft, into such breadths and thickness as to form plaiting of different fineness, which may be stitched or sewed up into hats, &c. in the same manner as straw or chip hats are manufactured, after which it may be dried, stained, or varnished.

A similar process may be used for manufacturing harps, or riddles for cleansing corn or other grain, and for manufacturing bottoms and sides of sieves which are free from any dangerous or pernicious quality, or for manufacturing backs and seats of chairs, sofas, gigs, and coaches, or the bottoms of beds, or reeds for weavers.

Whalebone may also be manufactured into girths, by immerging it while hot into oil for some days, which renders it more pliant and stronger than before; after which it may be cut while warm and pliant into proper breadths for traces, &c. A plaiting or narrow webbing may also be made of the pliant slips, to be used as reins, or straps. Whalebone prepared in this manner is less liable to rot, and more durable than leather.

Observations.—The elasticity of whalebone being so superior to that of the other articles in whose place it is meant to be employed, must certainly give some of them a quality which is very desirable, particularly in the manufacture of soldiers' hats, as they would thus fit closer to the head by assuming the proper form of it.

In womens' hats and bonnets the elastic quality does not seem to be required, and we apprehend the use of whalebone for these articles must be far inferior to the plaited straw now used.

Although whalebone might be perhaps advantageously employed for the straps of barouche seats, and of the one-horse carriages constructed in a similar manner; yet we apprehend that its use in harness would be impracticable, or at least attended with much hazard of continually breaking, by the force of the draught, to say nothing of the difficulty that must soon occur of finding a sufficient supply of whalebone, if it should come into general request.

The same observation will apply to its use, in lieu of the sacking or laths used in bedsteads. We could not refrain from a smile on reading this use of whalebone proposed, as the recollection of Dr. Graham's celestial bed occurred to our mind.

Earl STANHOPE'S *Patent for Improvements in the Form, Construction and Manner of building and fitting-out Ships and Vessels for Navigation, and especially for counteracting Dangers from submarine Explosions. Dated Feb.* 1807.—*Repertory of Arts*, No. 67, New Series.

THE Noble Earl in the introductory part of his specification states, that the object of his invention is to construct vessels which, as far as in the nature of things it is possible, shall unite the "*maximum*" of advantages with the "*minimum*" of disadvantages, and his lordship trusts that he has successfully solved this high and important problem.

The drawings attached to the specification, exhibit the plan, section, and elevation of a flat-bottomed canal boat or barge, somewhat sharpened at each extremity as its depth increased, so as in these parts in some degree to resemble the structure of a Thames wherry, but still possessing the most marked affinity to a flat-bottomed canal boat.

Under each bow, and each quarter of the vessel so shaped, an apparatus is directed to be placed, consisting of a number of square plates, about the size of port-lids, and moveable on hinges vertically in the same manner, which his Lordship calls *gills*.

In the drawings of the vessel referred to in the specification, thirteen of these *gills* are represented under each bow and each quarter, in all fifty-two; and each of them are directed to be moved up and down by a combination of short levers, enclosed in a metal case let into the substance of the plank, and ultimately put in motion by a rod working backward and forwards in a stuffing-box.

Each gill is directed to be about two feet square; but the size may be varied according tc circumstances, and they are to be made of stiff metal, about three-eighths of an inch in thickness; when shut up, they lie close to the plank of the vessel, into the thickness of which they may be embodied, and then produce no action in the vessel; when protruded outwards to their full extent they project in a vertical direction from the vessel; and as the line in which they are arranged, slopes in from the extreme breadth towards the central axis of the vessel, they form vertical planes inclined in a certain angle to the vertical planes of the said axis, which have a tendency to operate in turning the vessel about in a manner similar to a rudder, inclined in a similar angle; but with more power when their action is combined.

Their effect may be increased or diminished according to the degree of their protrusion from the vessel; and they may be made to prevent the vessel from making lee-way, or even to work her to windward, by bringing those at opposite sides, at the bow and stern into action at the same time. Vessels built and fitted up according to this plan, his Lordship intends to call *Stanhope's Weatherers*.

His Lordship recommends building vessels without any inside plank, and to increase the thickness of the outside plank in proportion; which he conceives will increase the strength and durability of the vessel. In speaking on the subject of coppering ships, his Lordship declares the shape of his Stanhope Weatherer much better calculated than that of other vessels, having the copper applied to it "in the intimate (or close) manner necessary for perfection." He also recommends a composition of his invention to be laid over the vessel previous to the coppering, instead of the tarred paper commonly used; which composition consists of three parts of very dry pounded chalk or brick dust, and one part of thick, but not ropey vegetable tar, first well mixed and then boiled together to the consistence of bees-wax. It should be laid on the planks hot with a hot trowel, to about the thickness of a shilling, and when this coating has become perfectly dry, a second should be applied a quarter of a inch thick. The sheets of copper should be laid on hot over both these coatings, with a thin layer of the composition spread over the sides of the sheets intended to be next the plank, which should be made to bed flat and even by means of wooden mallets."

His Lordship also recommends that the treenails be driven obliquely into vessels, and that some of the planks be an inch thicker than the rest, and be let into the substance of the timbers and beams, one inch at the sides and on the decks. The obliquity of the treenails will hold the plank morestrongly to the timbers, or as to prevent its being forced outwards by the effect of calking, being driven with too great violence, and this position of the planks will prevent the calking from driving the rest sideways from their proper places. He points out here an advantage of his *weatherer,* arising from the small inflection necessary for the planks in vessels so shaped, which diminishes greatly the danger of planks starting from the sides, or of springing buts; which has caused the loss of many ships. His Lordship also expresses his disapprobation of some proposed methods of ship-building; but from the vague manner he mentions the subject, we cannot readily conjecture what methods he means. We know of none that will precisely answer to the idea excited by the expressions used.

Stanhope weatherers are made very long; it is directed that in order to strengthen them, "a stout tabled bulkhead, ten or twelve inches thick, be placed fore and aft in the centre of the ship," to extend lengthways from the stern cabin to the raking stern, and (vertically) from the bottom timbers to five feet at least above the load water-line, and "if a sufficient number of bulkheads, properly calked, and strongly connected to the sides of the vessel, were placed across ship, in addition to the fore and aft bulkhead, great additional strength and security would be obtained.

Another advantage of the *Stanhope weatherer* is stated to be, that from its shape, very few moulds will be necessary in its construction.

Directions are given as to the preparation of oakum; stating that it should always be made of new hemp, and that the sort prepared from old cables, or junk, should never be used.

A description is given of what his Lordship calls an *equipollent* rudder, formerly invented by him; this rudder is double the usual breadth, and is hung so as to turn round its central vertical line, by which means one half of it operates at one side of the vessel, and the other half at the other side, at the same time.

His Lordship concludes his specification by stating some contrivances for preventing submarine explosions, for the application of which he mentions the *Stanhope weatherer* to be remarkably well calculated. The first is described in the following words; "From long spars placed on the deck, and inclined forwards and outwards, I can, moreover, outrig the prow of the vessel, at several yards before the stem, by means of ropes, metal bars, common chains, or chains with long links; two of which should be placed vertically before the prow; two more of which should extend vertically or obliquely several feet beyond the line of her sides, and one other of which should extend horizontally three or four feet below her bottom." These contrivances are called *protectors*. The other apparatus for the same purpose, "consists of a long thin board or edge sunk to any required depth by means of metal ballast fastened to its lower edge; this is kept in the position required by cork floats, connected by cords to each end of it. The board has head and stern rudders fixed to it at a certain angle, by which, when drawn forward by the vessel, it tends to move off laterally from it. This board so fitted up his Lordship calls a *straddler*. One of them is to be towed at each side of the vessel, from an iron bar placed at its stern. The tow-lines are to be kept under water by small leads, and are to have lines stretched between them and the *straddlers*, to sweep the whole space between them as the vessel proceeds on its voyage.

Observations.—Flat-bottomed vessels can never be made so strong as those which have curved bottoms, because the connection given by shifting of timbers in the latter, is entirely cut off in them, their bottoms forming a distinct framing from the rest of the vessel, instead of a well united part of the whole hull, as in others. The flat-bottom may indeed be firmly connected to the sides by having a good knee placed at every frame of timbers, but still the angle will be the weakest part, both on account of the greater chance there exists of knees being cut across the grain, and because a quadrangular piece of frame work, such as the section of a flat-bottomed vessel, opposes vastly less resistance to any force tending to alter its shape, than a circular or triangular form. The quantity of knees too that would be required for the above use of them, would occasion an enormous expense, on account of their high price.

Flat-bottomed vessels are also much more liable to be leaky than

others, even in the vessels used in the still water of canals this fact is strikingly observable, and it is obvious that the violent agitation of the ocean must greatly increase the evil; and on these grounds we cannot approve of the flat-bottoms of the *Stanhope weatherers.*

Many of the plans mentioned by his Lordship seem indeed merely calculated for still water; among which we must class the *equipollent-rudder*, the *protectors*, and the *straddlers*, all of which a heavy gale of wind, and rough sea, would speedily tear away from the vessel; the *equipollent rudder* might resist a little longer than the rest, but as it is merely secured to the vessel at the rudder head, and has no support of rudder irons or hinges, or any substitute for them from the rudder head to its keel, any seaman can judge how soon it must yield to the violent concussions of a stormy sea.

That shape of the aft part of a vessel, which will leave least wake, or hollow tract after it in sailing, is that which causes the vessel to make least resistance in the water. It can be proved that vessels which slope off aft from the sides to the stern post, as *stanhope weatherers* and canal barges, will leave a greater wake than vessels which are sloped from the bottom upwards, as well as from the sides to the stern post; and therefore we are convinced that such vessels will sail slower than if their sterns were formed in the manner of frigates, the slope of the rim being equal in both cases.

When planks are arranged at both sides of the ribs or timbers, the treenails (which tie all the parts together, and on which the strength of the ship ultimately depends,) have an equal bearing on both sides, that nearly makes the strength afforded by them double that which they give, when the planking is but at one side, nor can any thickness of outside plank do away this circumstance. Hence when the strength of vessels depend merely on the plank and timbers, arranged in the common mode of ship building, inside plank is indispensibly necessary. It is however, a grand object to do without it, and would certainly cause a great saving, and have the other advantages pointed out by his lordship; but to do it with safety is very difficult.

In the second volume of the New Series of the Repertory of Arts, p. 81, is the specification of a patent granted to Mr. Boswell for a method of building vessels, whose strength depends on an internal framing independent of the ribs and planking, which of course renders the support given by inside planking unnecessary, and, on that account, a vessel built according to his plan (as described in vol. iv. p. 130 of the same work) requires only a casing of inch board at the inside, merely to keep dirt from lodging between the sides, The strength of this method has been fully proved by the vessel thus constructed having, according to an account published in vol. vi. p. 187, of the work just quoted, been in the West-India trade upwards of three years, and withstood frequent storms and boisterous seas, without the least injury.

The bulk heads which his lordship recommends, would have great advantages; but their use had been suggested in England long before the date of this patent.

In Sewell's collection of papers on Naval Architecture, published some years ago, various plans of this kind may be found. Capt. Schank used water-tight bulk heads long since in the vessels in which he introduced his sliding keels; General Bentham had them placed in most of the vessels built on his new projection a few years since; and some account of them may be found in Gordon's principles of Naval Architecture published in 1784, to which may be added, that water-tight bulk-heads have been used in the Chinese ships for time immemorial.

Bulk-heads, or framings across ship, afford great strength, but are objected to by seamen, because they tend to interrupt the stowage of casks, and other long packages. If the packages or casks used were all of the same length, it would however be easy to arrange the bulk-heads so as not in the least to interrupt the stowage, merely by placing them at such a distance asunder, that three, four, or more casks, placed in succession, could fill up the interval between them without waste of room. A bulk head fore and aft in the ship, would also greatly add to its strength in that direction; but a framing in the same position, formed of a few pieces in addition to the stannions, would have nearly the same effect at a much less cost, and would be much lighter.

The *Gills* are the principal novelty in his Lordship's specification: The great number of them proposed, would occasion a complication that would be peculiarly unfit for sea service; having the planks cut through in so many places for the lever boxes would expose the ship very much to the danger of troublesome leaks in stormy weather; and the method of working the gills proposed, would be also liable to derangement, from the rough handling they would have to encounter. If any one of the gills happened to get out of order, so as to remain immoveable in a protruded position, it would have an immediate tendency to turn the ship out of its course, which might be of dangerous consequence in violent gales, or when the vessel was tacking off a leeshore.

TO prepare and print an Index to a Periodical Work of so many articles as this Publication contains to accompany the last Number of the Volume is nearly impossible in the short period between the completion of the printing and the day of publication; and the method adopted in many publications of giving it in the first number of a following volume, is productive of many inconveniences.——On the 1st of March therefore will be published, a Supplementary Number, price 2s. containing an account of the remainder of the articles that should be noticed in the present Volume, but which our limits have not yet enabled us to introduce; together with the Index, Title, &c. and Table of Contents for the Second Volume.

Each Volume will in future be completed by a Supplementary Number on the 1st of March, in each succeeding Year.

No. XIII. being the next Quarterly Number, will be published May 1st, 1808.

RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL AND AGRICULTURAL

DISCOVERIES.

No. XII.] *SUPPLEMENT.* [1807.

AGRICULTURE.

A Method of cultivating Carrots, and applying them as Food for Cattle.—By J. C. CURWEN, Esq. M.P.—*Trans. Soc. Arts.* Vol. 24.

As soon as the corn is cleared, Mr. Curwen stitches up the ground, and leaves it in that state during winter, which greatly facilitates its working in the spring: he breaks it up again in April, and by giving three or four ploughings and some manure, brings it into garden tilth: and in the beginning of May sows the seed, which has been previously mixed with wet sand and placed in a warm situation on high ridges three feet asunder. By this method the seed is in a state of vegetation before it is sown, so that a fortnight is gained by it, and the carrots are less liable to be injured by weeds. The plough and harrow are kept at work during the summer to clean the intervals, and the plants are hand-hoed and thinned. This gentleman sowed an acre and a rood in this manner in 1804, and the tops of the crop were sufficiently abundant to feed twenty head of cattle for a month. He employed women to take them up with forks, and the produce was 4143 stone (of 14lb) which at 6*d.* per stone was worth 103*l.* He considers it essential that the carrots should be taken up early enough in the autumn to be perfectly dried by the weather; they will not otherwise keep. Mr. Curwen states it to be his custom to give his working horses 8lb. of oats per day, one half of which was taken away and an equal weight of carrots substituted, and

the horses improved in their condition upon this food. When the carrots were taken up, a small piece was cut from the top of each to prevent it from vegetating, and those were immediately used. The remainder were piled in rows two feet thick and five feet high, leaving a space between each row for a free circulation of air; and in this way they were found to keep a considerable time.

Observations.—Mr. Curwen states that he was induced to cultivate carrots from the observations of Mr. Arthur Young in his Report on the Agriculture of Suffolk, where many useful hints will be found on the culture of this valuable root. The experiments of Mr. Curwen have fully sanctioned the favourable opinion of the carrot as food for horses, which had been previously entertained by the Editor of the Annals. It is now sufficiently evident that they may be beneficially substituted for half the usual quantity of corn, though it would seem that if they were given instead of corn altogether horses would not thrive upon them equally well, but this remains to be ascertained by comparative experiments.

On Hemp. By Mr. A. Young.—*Annals of Agric.* No. 265.

The writer thinking it probable, (and subsequent events have unfortunately verified the opinion) that we may find ourselves in a situation which will demand a very great supply of hemp, without the usual channels of procuring it, submits to his readers a few suggestions on the subject of its culture. He states the value of hemp imported to be about 600,000*l.* annually; and as the essential defence of the kingdom may absolutely call for an increase of our hemp-culture to the amount of that quantity, he considers it not unnecessary to think a little on the subject before-hand. The points which he particularly insists on are, that hemp succeeds well in drained bogs, that it succeeds well on newly broken-up grass land, and is a good preparation for wheat; these he considers important circumstances and such as claim attention, when the necessity comes of supplying ourselves. He asserts it to have been proved by an experiment in Huntingdonshire that hemp succeeds well on bogs, for a peat-bog there produced fifty stone per acre, which is a fair crop on the very best lands; and this produce he considers perfectly agreeable to reason, for bogs when drained are natural dung-hills, and the richest of all soils; and it is not therefore surprizing that they should yield great crops of hemp as well as of every other plant. That it succeeds well on newly broken-up grass lands is too extensively proved in the few districts, where it is cultivated, to admit of any doubt; and its usefulness as a preparation is a fact ascertained in every country where it is cultivated. As hemp is an essential article in the equipment of the navy, if it cannot be imported, it must be raised

in the country, and Mr. Young thinks there is far more national benefit in drawing hemp from uncultivated bogs, than from lands which are already employed in the production of useful crops, and that the expense of improving such wastes would be amply repaid by the produce.

Observations.—The subject of this paper (in the present state of Europe) is equally interesting to the agriculturist and the politician. The increasing demand for food in this country certainly requires that as little land as possible should be withdrawn from that purpose, and the suggestion of draining bogs for the cultivation of hemp is highly deserving of attention.

Some Account of the Hill-Wheat of India. By Sir Joseph Banks, Bart. K. B. P. R. S. &c.—*Horticultural Trans.* Vol. I. Part I.

Seven or eight years ago Sir Joseph Banks received from a Mr. Lambert a small paper of seeds, on which was written "*Hill-Wheat.*" On examination, the seeds were found to be scarcely larger than those of our wild grasses, but when viewed through a lens, they perfectly resembled grains of wheat. Of these seeds Sir Joseph sowed some, and Mr. Lambert the remainder. Both crops very unexpectedly proved to be wheat of the spring kind, and the usual size, the grains of which were nearly as large as those of common spring. On this Mr. Lambert inquired of the lady, from whom he had obtained the seeds, for information of the country from whence they came, but she had forgotten the exact history of them, and only knew that they came from India, but from what part she did not recollect. From the writing on the paper being "*Hill-Wheat,*" Sir Joseph Banks concludes that they came either from the peninsula, or from the hilly country far within land from Bengal, as the province of Bengal itself is a flat alluvial soil entirely level.

Observations.—This account of *Hill-Wheat* is particularly interesting, as it tends to ascertain two of the greatest desiderata of cultivators—the country where wheat grows spontaneously, and the nature of the grain in its original state, when unassisted by the fostering hand of man. As the subject has been now public, probably some one, who has been in India, may point out, what it is of some importance to know, whether this wheat is a cultivated or a wild plant, as in the latter case the difficulties will be removed which botanists have so long experienced respecting the native country of wheat; and their researches on that point will here find a satisfactory termination.

On raising new and early Varieties of the Potatoe (Solanum tuberosum). *By* THOMAS ANDREW KNIGHT, Esq. F. R. S. &c.—*Horticultural Transactions,* Vol. I. Part I.

Observations.—THIS paper is merely an abridgement of the communication on the same subject made to, and published by, the Royal Society. As we have noticed that more complete account of the experiments in a former number in an article from the Philosophical Transactions, it would be only recapitulation to give any detail of them here. We cannot however but regret that the committee appointed to superintend the publication of their papers should have admitted into their collection a communication far less perfect than one which had been previously published by another learned body.

An Essay on the Grasses and other native Plants most deserving of Culture in Scotland for Hay or Pasture. *By the* Rev. WILLIAM SINGERS, *of Kirkpatrick-juxta, Dumfries-shire.—Trans. Highland Society,* Vol. 3.

Observations on some of the indigenous Grasses of Britain which seem deserving of Culture for Pasture or Hay. *By* Mr. GEO. DON, *of Edinburgh.—Trans. Highland Soc.* Vol. 3.

THESE two essays are so similar in their subject and the manner in which it is treated, that we have included them both in one article. From their nature they are in a great measure incapable of abridgment, as they consist almost entirely of lists of grasses accompanied with descriptions and accounts of their properties and uses. These are interspersed with many valuable observations, both scientific and practical, which will amply repay the labour of perusing the original papers. To have attempted to give a detailed account of the contents of these essays would have been an equal injustice to the authors, and to our readers, for the limits to which the retrospect is confined would have necessarily rendered any such account very imperfect. We have therefore thought it our duty merely to notice these two productions in the terms of approbation which they merit, and to refer such of our readers as are desirous of perusing them, to the volume of the Transactions of the Highland Society, in which they are given to the public.

On preserving Turnips in the Winter Season. By Mr. James Dean, *of Exeter.—Trans. Soc. of Arts,* Vol. 24.

Mr. Dean communicated this article from the practice of a farmer in Devonshire, who got his turnip seed into the ground early in June, so that the turnips had attained a large size in October; in that month he had the largest of them drawn without injuring the leaves, and then placed close to each other on the grass in the orchard in the same position in which they grew. The leaves preserved them from external injury, and their top roots soon put out fibres into the grass, which had been suffered to grow long in the autumn, the more effectually to protect them. By this contrivance the turnips were preserved fit for use to a late period of the winter.

Observations.—The plan pursued by the Devonshire farmer, as detailed in this communication, certainly displays much ingenuity, and may, in many instances, be adopted with advantage; but it is removing the turnips from off the ground, instead of eating them there, which is not generally considered the most husband-like manner of consuming this kind of crop, where the nature of the soil will admit of a different practice.

Account of a useful Drillhoe Harrow, adapted for the Drill Culture of Turnips. —By Mr. Charles Waistell, *of High Holborn.—Trans. of the Society of Arts, &c. Vol.* 24.

This implement, which Mr. Waistell states to have been first used a few years since at West Park near Barnard castle, consists of two beams meeting in a small angle; at the point of the angle is placed a coulter, behind the coulter, a hoe, and behind the hoe teeth of a harrow extended to the farther end of each of the beams; and the writer does not know of any other implement of equal efficacy for destroying weeds, and pulverizing the soil in the interval of drilled turnips. It is drawn forward by a horse walking between the rows, which ought to be about 27 inches from each other.

Observations.—This implement has not much claim to novelty, for it is only a variation of the nine-share plough of Wiltshire, from which the scuffler originated, it is however, in its present form, well adapted for the intended purpose.

On the Comparative Culture of Turnips. *By* CHARLES LAYTON, Esq. *of Reedham-hall Norfolk.—Trans. Soc. Arts, Vol.* 24.

MR. Layton being being desirous of ascertaining by experiment the best mode of cultivating turnips, in 1805, prepared 20 acres of land for that purpose; The field was level and the soil similar, and equally manured with rotten farm yard dung, ten loads to the acre, after having been properly summer tilled. He divided the field into ten equal parts, and sowed them alternately drill and broadcast, the drills were twelve inches asunder, and no part of the crop failed; the parts were all hoed at the same time, and the plants equally thinned out; the expense of the drilled part was about 8*s.* per acre, and of the broadcast 7*s.* sixteen perches of each kind weighed as under:

	ton	cwt.	st.
The drilled crop - -	1	19	0
The broadcast crop - -	1	14	4

which gives a difference in favour of the drilled crop of $4\frac{1}{2}$ cwt. on sixteen perches, which is at the rate of 2 ton 5 cwt. per acre.

Observations.—This experiment appears to have been very impartially conducted, and may be considered decisive of the preference due to the drill. It ought, however, to be taken into the account, that though the drilled crop exceeded the broadcast by more than an eighth part, yet the extra expense of providing drills, &c. ought to be set against it. However on this principle of calculation the advantage is decidedly in favour of the drill.

On the Cultivation of Potatoes, and on Turnip-husbandry. *By the* Rev. MR. CAMPBELL, *of Kilcalmond.—Farm. Mag.* Nos. 31, & 32.

THIS long essay, which consists of two distinct parts, the former relating to the cultivation of potatoes, and the latter to the turnip-husbandry, has been divided by the editor of the Farmer's Magazine, into two distinct papers, and been published in different numbers; as however, they are only parts of the same whole, and as the subjects are treated in a similar manner, it is thought right to include them here in one article. The implements employed for these purposes, though none of them are peculiar to his own practise, are described by this writer, with a tedious minuteness, and are farther illustrated by drawings, which have been engraved for the magazine. Not only every preliminary operation in preparing the land, but even the mode of performing each, is de-

scribed with as much prolixity, as if the cultivation of these vegetables was now practised for the first time in this kingdom. The whole work of preparation, however, may be comprized in the simple description of causing the land to be completely pulverized, and the whole management may be reduced to sowing the seed at a more early period than is usual, and keeping the crop free from weeds with oriental scrupulosity. The recommendation to frequently earth up both potatoes and turnips, (the latter being sown in drills) is worthy attention, and the advice to carefully watch and guard the crop from sparrows, and other small birds, when the turnips are beginning to peep through the surface, and for a few days afterwards will be attended to by the prudent agriculturist.

On a Machine for Extirpating Thistles, which is used in Essex; By ANTI-CARDUUS.—*Dickson's Agric. Mag.* No. 5.

THIS implement is employed on a fallow for the purpose of extirpating thistles, it consists of a strong knife fixed by a perpendicular iron at each end to the handle of a beam, somewhat like a plough beam, the other end of which beam rests on the axle of a pair of low wheels, those used in the instance described were the fore-wheels of an old chaise. The wheels keep the beams always at an equal height from the ground, and the workman by bearing on the handles of the machine causes the knife, which meets the ground with a straight edge, to cut the roots of the thistles within the surface of the ground, by which means they are destroyed with less trouble and expense than by spudding, and more effectually, than by mowing. It is suggested that this implement would be improved by shaping the knife in a triangular form, like the share of a scuffler with a coulter in front, and that the same principle might be applied to cutting beans and peas, especially the latter.

Observations.—The machine here described may be useful in its present state, but would be more so, if the knife were formed in a triangular shape. It is, however, matter of doubt, whether the common scuffler, or nine-share plough of Wiltshire, provided the shares were broad enough to cover the extreme points of each, would not answer the purpose much better, as it would not only extirpate the thistle with equal certainty, but would also stir the land at the same time, and would probably require less power of draught.

On the Quendon Barrow, for conveying Water and other Liquids. By a CANTAB.—*Dickson's Agric. Mag.* No. 5.

THIS barrow differs from the one described in a former magazine, only in the circumstance of the axis of the tub for containing the liquids resting on the frame of the barrow, instead of being placed at the meeting of two pieces of wood about two feet higher, the pieces being mortised into the frame. It is said to have been long in use at Quendon, near Saffron Walden in Essex, and takes its name from that place.

Observations.—The same remarks which were made on the barrow described in the former number, apply equally to this, as it is only a variation in the construction of the same implement.

On an Improvement of the Common Harrow. By I. T.—*Dickson's Agric. Mag.* No. 5.

THIS improvement consists in placing the teeth in such a manner in the bulls, or frame of the harrow, and to obtain by means of shifting the land-tree or guide, a greater probability of causing the teeth to pass over the land in separate lines, instead of several following one another, as is the case in the common harrow.

Observations.—The effect of this improvement is by no means certain, and the whole implement so very inferior to the patent harrow of Mr. Lester, as not to merit a moments consideration. We consider the patent harrow of that gentleman to be the most perfect and complete implement of the kind, that was ever introduced into this or any other country.

On Hatching Fowls by Artificial Heat. By a POULTRY BREEDER.—*Dickson's Agric. Mag.* No. 5.

THIS writer relates his want of success in numerous attempts to hatch and raise fowls by artificial heat. The risk of hatching the eggs either in dung or over charcoal fires, he states to be inconsiderable, though the trouble is very great; he found the chief difficulty in bringing up the chickens when hatched, "a thing sufficiently uncertain, he observes, in a great part of this country, even under the natural mothers, but bordering upon an impossibility under artificial ones." He tried in vain the methods recommended by Reaumur, and other writers on this subject, and yet found them eternally distressing his ears with those melancholy cries, which indicate approaching dissolution. He concludes by expressing his conviction that the plan is impracticable in this country.

Observations.—No trouble or attention appear to have been spared, nor any care omitted, in the trials mentioned in this paper, and their uniform want of success may afford a lesson to others, who are disposed to try similar experiments, and preserve them from the vexation of hopes perpetually disappointed.

HORTICULTURE.

On the Economy of Bees. By T.A. KNIGHT, Esq.—*Philosophical Transactions for* 1807. Part 2.

THIS gentleman resides mostly in the country, and employs his leisure in promoting improvements in horticulture, and his superior knowledge in this point is sufficiently evinced by those experiments on trees, which have been so frequently recorded in the Transactions of the Royal Society. Amongst other amusements connected with a garden, he has paid some attention to the economy of bees, and the subject of the letter tends to prove that the generally-received opinion, that each hive or swarm of these insects remains at all times wholly unconnected with other hives in the vicinity, and that the bee never distinguishes a stranger from an enemy, is not well founded; for he has discovered that a friendly intercourse not unfrequently takes place between different hives, but is also sometimes productive of important consequences in their political economy.

In August 1801 he observed several bees passing him in a direct line from the hives in his own garden to some in the garden of a neighbouring cottage; and as this was later in the evening than these little animals usually labour, he was induced to attend particularly to the circumstance, and went alternately to his own hives and those of the cottager to make observations. He found much bustle and agitation prevailing in one hive at each place, every bee appearing to be stopped and questioned at its arrival at the mouth of the hive, though no actual hostility took place. He observed this amicable intercourse to continue for several days, but on the tenth morning their friendship ended in a quarrel, a furious battle ensued, and after this there was no more visiting.

Two years afterwards Mr. Knight noticed a similar intercourse to exist between two hives placed in different parts of his own garden; in this instance however a rupture took place on the fifth day and terminated their friendship.

He is inclined to think from these observations that such kind of intercourse is by no means uncommon, and not unfrequently ends in a junction of the two swarms, and adds, that instances of this have come within his observation, and though some fighting always takes place when bees quit their hives, he conceives this to be between the bees of the adjoining hives, and those which are

removing, the former being attracted by the scent of the honey which the latter were carrying off.

He is also of opinion, that for several days previous to a swarm quitting the hive a small number of bees, varying from twenty to fifty, are sent out to discover a proper habitation for the new colony; for, on the farm which he occupies, there are many decayed trees, the cavities of which have been occupied by bees, and which he fits up with boards for that purpose; and whenever a swarm came to any of these, he constantly observed that for about a fortnight previous to their arrival, a small party of bees were every day employed in examining, and apparently in keeping possession of the place; nor was their examination confined to the cavity alone, but extended to the external parts of the tree, and every dead knot particularly arrested their attention; and he has frequently noticed that when swarms of his own bees took possession of these cavities, they deviated very little from the direct line between one point and the other, which seemed to indicate that the bees which formerly acted as purveyors now performed the duty of guides; and in one or two instances, where he has suspected their destination to be a particular cavity, he has left a servant to watch their motions and follow them, and has himself, by running briskly, got to the place before them and witnessed their arrival at the expected spot. He concludes therefore that when a swarm of bees, which have issued from the parent-hive, soon settle on some neighbouring bush or tree, their object is nothing more than to collect their numbers, and they have generally another place to which they intend subsequently to go, which is in most instances the best they can discover; and he is much disposed to doubt whether it be not rather habit produced by domestication, during many successive generations, than any thing inherent in the nature of bees, which induces them to accept a hive when offered them in preference to the situation which they had previously chosen; for he has noticed the disposition to migrate to exist in a much greater degree in some families of bees than in others, and remarks that the offspring of domesticated animals in a very remarkable manner acquired the habits of their parents, and instances the different habits of the terrier and the spaniel, which are only different varieties of the same species of dog, and to that species none of these habits are given by nature. Bees appear to him to be susceptible of these changes of habit, like other animals, and therefore when accustomed for many generations to a hive, they become more dependent on men, and rely wholly on his care for a habitation.

A remark by Mr. John Hunter, that the matter which bees carry on their thighs is the farina of plants with which they feed their young, and not the substance with which they make their combs, he believes to be perfectly correct; but has observed that they will also carry other things on their thighs. Having frequently covered the decorticated parts of trees on which he was

making experiments with a cement of bees-wax and turpentine, he has in the autumn observed a number of bees carrying off this substance, after detaching it from the tree with their forceps. The portion thus obtained was transferred by the first to the second leg, by which it was deposited on the thigh of the third, in the same manner as the farina of plants; this substance he apprehends to have been solely applied to attaching the hive to the board on which it was placed, and perhaps to exclude other insects and air during winter. While the bees were thus employed he had many opportunities of observing their peaceful and patient disposition which Mr. Hunter has noticed. A bee has been despoiled of its load when completely collected, and afterwards of a second load, and even of a third, by some adventurous robber, and has yet pursued its labour without betraying symptoms of either impatience or resentment. When the hive is approached, the bee often appears to be the most irritable of all animals; but from a circumstance which he has noticed among a species of animal of similar habits, he does not conceive this irritability to arise either from a sense of injury or apprehension of the individual who makes the attack; for, if a nest of wasps be approached without alarming its inhabitants, and all communication cut off between those out of the nest and those in it, no provocation will induce those which are from home to defend either the nest or themselves; but if one escapes from within it comes with a very different temper, and appears commissioned to avenge public wrongs, and be ready to sacrifice life in the execution of the commission. Mr. Knight relates that he discovered this circumstance at an early period of life, and when a school-boy had availed himself of the discovery so often as to be certain of the fact, and has no doubt from some imperfect experiments that the actions of bees, under similar circumstances, would be the same. He does not agree with Mr. Hunter in the opinion that bees-wax is an animal substance which exudes between the scales of the belly of the insect, but is disposed to believe it to be collected from the plants, and merely deposited for being carried with convenience, and giving the temperature necessary for being moulded into combs; and he strengthens this conjecture by the circumstance of wax being frequently found in the vegetable world; differing however from Mr. Hunter (whose conclusions he believes to have been drawn with caution, skill and industry) with too much hesitation and diffidence to put his own opinion in opposition to his authority.

Observations.—The ingenious gentleman, to whom the Royal Society are indebted for these Observations on the Economy of Bees, has frequently enriched their Transactions, as well as the Transactions of the Horticultural Society, with detailed accounts of his experiments on trees and vegetables, many of which have been noticed in the preceding numbers of this work. And though

the information conveyed in the present paper be not of extensive application, yet it furnishes some new and pleasing traits of the economy of a tribe of animals, whose habits are but little understood. The facts appear to have been carefully collected by the writer himself, and his deductions are fully warranted by the premises laid. Though the author's modesty would not allow him to place his own opinion in opposition to Mr. John Hunter's, yet we should not do him justice if we did not consider it as, at least, of equal authority on subjects connected with the cultivation and inhabitants of a garden.

On the Revival of an obsolete Mode of managing Strawberries. By Sir Joseph Banks, Bart. K. B. P. R. S. &c.—*Horticultural Transactions,* Vol. 1. Part I.

It is observed in this paper that the custom of laying straw under strawberry plants, is probably very old in this country, and that the name of the fruit bears testimony in favour of this conjecture; for the plant has no relation to straw in any other way, and no European language applies the idea of straw in any shape to the name of berry, or to the plant that bears it. When Sir Joseph Banks went to Spring Grove in 1779, he found this practice adopted by the old gardener there, who had learned it soon after he came to London from Scotland, at which time he had worked among the market gardeners. He conceives its use in preserving a crop to be very extensive; it shades the roots from the sun; and prevents the waste of moisture by evaporation; and consequently, in dry times, when watering is necessary, makes a less quantity of water suffice, than would be used if the sun could act immediately on the surface of the mold, besides, it keeps the fruit from resting on the earth, and gives the whole an air of neatness as well as an effect of real cleanliness, which should never be wanting in a gentleman's garden. The whole strawberry beds at Spring Grove are stated to consist of 600 feet of beds, and the straw required for them was twenty trusses, which at 10*d.* a truss amounted 16*s*, 8*d*, from which the value of the manure made by the straw, ought to be deducted, the cost of the practice cannot, therefore, be considered as heavy. In the year 1806, not a single shower fell at Spring Grove, from the time the straw was laid down till the crop of scarlets were nearly finished, the expense of strawing was therefore many times paid, by the saving made in the labour of watering; and besides, the berries themselves were under this management as fair and nearly as large as in ordinary years, but the general complaint of the gardeners this year was, that the scarlets did not reach half their natural size, and of course required twice as many to fill a pottle, as would do it in a good year. And though in this point of view the straw is of less importance in wet years, yet even then it is of considerable service; for heavy rains never fail to dash up abundance

of mold, and fix it upon the berries; this is entirely prevented, as well as the dirtiness of those berries that lean upon the earth, so that the whole crop is kept clean and pure; and in years moderately wet, the use of strawing sometimes makes watering wholly unnecessary. In the conclusion he remarks, that no earthy taste will be observed in eating the fruit that has been strawed, and the cream which is sometimes soiled when mixed with strawberries, by the dirt that adheres to them, especially in the early part of the season, will retain to the last drop "that unsullied red and white, which gives as much satisfaction to the eye while we are eating it, as the taste of that most excellent mixture does to the palate."

Observations.—The reasoning of this learned member of the Horticultural Society, cannot but be received with great attention, since it is addressed not only to the skill and pride of the gardener, but also to the palate of the epicure; the luxury of a nice and delicious repast will attract the admiration of the latter, and the hopes of obtaining this fruit in the highest state of perfection will stimulate the industry of the former. The name of strawberry certainly makes it extremely probable that the practice recommended in this paper was not unknown to our ancestors, and the many advantages to be derived from it are fully sufficient to promote its adoption by the Horticulturists of the present generation.

On the Cultivation of Polyanthes Tuberosa, or Tuberose. By Richard Anthony Salisbury, Esq. F. R. S.—*Horticultural Transactions*, Vol. 1. Part 1.

This paper, which is accompanied by an elegant and accurate engraving of the tuberose, gives a detailed botanical description, and a long history of the plant, and of the knowledge and cultivation of it in foreign countries. It is stated that Parkinson is the first English writer who mentions the tuberose, and after him Philip Miller in the first edition of his Dictionary in 1731; he there makes it a distinct genus from *hyacinthus*, and describes the variety with double flowers, which was then only to be found in the garden of Monsieur de la Court, near Leyden, though it is now become exceedingly common in our well cultivated gardens; where it still maintains the superiority among the profusion of other fragrant and beautiful flowers; the roots, especially of the double variety, being obtained from the warmer provinces of North America, as well as from Italy. Mr. Salisbury asserts however, from his own experience, that there is no necessity to be indebted to foreign nations for a supply; for he has cultivated it for many years in the open air at Chapel Allerton, and has preserved it from the severest frosts with little more care than is bestowed upon the Artichoke. For this purpose, he advises to select a piece of ground that is perfectly drained under a south wall, or if

this cannot be spared, it must be defended on the north by a hedge of reeds, proportioning the bed to the number of roots wanted, as the same tuberose never blows a second time, but only the lateral ones, which are produced in great abundance round it: the soil in which they best succeed is a light sandy earth, mixed with a third part of very rotten cow-dung; the earth should be taken about seven or eight inches deep, along with the green turf, chopping it in very small with a spade, and turning it once a month for a year, before it is used, and if the earth be not very light, adding a quantity of sea-sand, or fine shelly gravel. The bed is directed to be prepared about the middle of April, by taking out all the old earth to the depth of about three feet, and filling it nearly to the top with fresh stable dung that has been cast into a heap for a fortnight to heat; and when the dung is laid evenly in the trench, treading each layer firmly down, reserving the smallest and shortest for the top; upon this the compost is to be laid eighteen inches in thickness, and to be sloping towards the south for throwing off the rains and receiving the benefit of the sun. The roots may be planted in a day or two afterwards at five inches distance from each other, observing to place them alternately in the rows, and that the crown is only just covered with earth: these plants should be the offsets of such tuberoses as flowered the preceding year; the roots of which had been preserved through the winter in sand. At night the bed should be covered, especially if the weather be frosty, with a double mat, and little or no water be given; when the leaves are an inch high, a little more compost should be added; and weeds at all times carefully removed. If the season prove dry it will require watering, and towards the end of June and July very copiously; from which period to the beginning of winter, nothing is requisite but to weed the bed, and to protect it from autumnal rains. About the first week in December, advantage should be taken of a dry day to clear away all the decayed leaves; and the bed should be thatched all over and at the sides with dry straw a foot thick, and worked in such a manner as to throw off the wet. About the middle of February, if frost does not prevent it, the roots should be taken up, preserving their fibres, and packed in very dry sand, and secured from the frost till April, when they are to be replanted as before. The second year some of the largest roots may be expected to flower; if they send up their stems early, it will only be necessary to stick them carefully when about a foot and a half high, and leave them to blossom in the open air; but when they appear later than July, they should either be removed into pots with a trowel, or the flower stem should be cut off, for the sake of strengthening the offsets; and the bed is to be thatched till February as before.

Observations.—This paper which points out the mode of cultivating one of the greatest ornaments of an English flower garden, will afford a highly gratifying treat, to those who make choice

flowers an object of their care. The minuteness with which every part of the process is described is necessary to convey an adequate idea of the culture of a flower, which is not yet considered naturalized to our climate; but which the ingenuity and discernment of Mr. Salisbury have proved may be cultivated with moderate trouble in many parts of England, and he thinks the soil in the vicinity of London, Richmond, Bath, Southampton, and Exeter, more particularly adapted for its reception.

On the Advantage of grafting Walnut, Mulberry, and Chesnut Trees. By Thomas Andrew Knight, Esq. F. R. S.—*Horticultural Transactions*, Vol. I. Part I.

Having found in a very extensive experience in the propagation of apple and pear trees, that the detached parts of bearing branches of old trees when employed as grafts, never formed what might be properly called *young* trees; the stocks appearing to afford nutriment only, and the new plants retaining in all instances the character and habits of the parent, and producing the fruit the second or third years after the grafts had been inserted; the writer was induced to hope that the effects of time might also be anticipated in the culture of other fruits, and that parts of the bearing branches, if detached and employed as grafts, would still retain the character and habits of bearing branches. In order to ascertain this by experiment he raised some two year-old Walnut trees in garden pots as high as the bearing branches of an old walnut tree by placing them on stands, and grafted them by approach with part of the bearing branches of the old tree. When a union had taken place, the grafts were detached from the parent stock, and the plants thus obtained planted in a nursery, where without any peculiar care or management they produced both male and female blossoms in the third succeeding spring, and would have brought their fruit to maturity but for the intervention of frost.

A similar experiment was also made on the mulberry tree, in which, for want of young trees, scions of a year old were used, which had sprung from the roots of a young tree the preceding summer. They were treated in the same manner as the walnut, by being raised in pots and then grafted: there were only two of these scions; one died, and the other succeeded and bore fruit the third year, and continues to do so every season.

As both the walnut and the mulberry succeeds so ill when grafted in any other manner than by approach, Mr. Knight does not recommend attempting to propagate these kinds by any other way, but as the Spanish chesnut usually succeeds when grafted in any of the common methods, he was inclined to make experiments on this tree by a different mode of grafting, and is induced to believe, from the few which he carried into effect, that, by selecting those varieties which ripen their fruit early in the au-

tumn, and by propagating with grafts or buds from young and vigorous trees of that kind of a fruit-bearing age, that this beautiful tree might be cultivated with much advantage in this country both for its fruit and timber.

His experiments with this view were not confined to these three kinds only, but were extended to many other species of trees, and always with the same result; and he expresses himself thoroughly confident from very extensive and long experience, that the graft derives nutriment only, and not growth, from the young stock in which it is inserted, and that with the life of the parent stock the graft retains its habit and its constitution.

Observations.—The regret which has been so long and so generally expressed by Horticulturists, respecting the great length of time necessary to bring some kinds of fruit trees to a bearing state, may be obviated by resorting to the practise of which this ingenious gentleman has detailed the first experiments of this nature. From his long and uninterrupted attention to whatever concerns a garden, and the improvement of every thing cultivated there, he may with much propriety be placed at the head of the first rank of living writers on subjects of horticulture; *his* plans may be pursued, and his management copied by the young gardener, without any fear of incurring disappointment. The practise recommended in this paper of grafting all treees of slow growth to accelerate their bearing, cannot be too soon brought into general use, and we are inclined to agree with Mr. Knight that the best way in all cases seems to be by approach.

An Account of some New Apples. By Mr. Arthur Biggs, *F. H. S.—Horticultural Trans.* Vol. I. Part I.

This intelligent gardener, exhibited many new varieties of apples, to the Horticultural Society at their meeting in December, 1806, and having been flattered by the wishes of many gentlemen then present to give some account of such as were new, and by what culture they were brought to perfection, he laid before the Society the communication, which is the present object of notice.

With respect to general management, he observes, that, when he has told that he is cutting old trees away, as the better ones advance, and is thinning the branches of the latter, also as they require, he states all the information that is to be communicated on the subject, having found nothing of more consequence to the health of the apple than plenty of light and air. He approves of the recommendation of Miller to plant standard apple-trees 40 feet, and dwarfs 20 feet asunder, every way, to remain, and an equal number to be planted in the intervals to be cut away as the others advance in growth, the additional expense of which he says will be repaid more than an hundred-fold in the few years the latter are suffered to stand. He observes that the apple-tree will grow rea-

dily by cuttings, and that trees raised in this way from healthy one year old branches, with blossom buds upon them, will continue to go on bearing the finest possible fruit, in a small compass for many years: he thinks trees raised in this manner peculiarly proper for forcing, and believes them less liable to canker, than when raised by grafting, though he is unable to assign any reason for it, having more than once experienced this in the *golden pippin*, cuttings of which remained seven years in perfect health, while grafts from the same branch of the same tree, cankered in two or three years. The knowledge, that the apple tree might be propagated by cuttings, he acquired by mere accident, some cuttings which he had stuck into the ground for marks of annual flowers having all made roots: the soil was loamy, and the season wet. He remarks that apple trees of considerable magnitude may be transplanted with great safety, if care be taken to preserve every possible root, both small and great, and to have the ground where they are to be planted ready open to receive them, so that their roots may be exposed to the air but a few minutes; their fibres should be disposed as horizontally as possible, and not too deep, and the months of September and October should be preferred for transplanting large trees; watering them well, if showers do not fall the same day; and if the leaves be not removed, they will make fresh shoots immediately, or at least push more vigorously in the spring: he always treads the ground exceeding firmly with his feet in separate layers of about an inch, which renders staking unnecessary, because he thinks that practice does more mischief than good.

Of the varieties of the apple cultivated under his care, which ripen early, he recommends the following: the summer pippin, Devonshire quarrington, summer traveller, bland rose, summer permain, red colville, marigold, Kirk's incomparable, Evan's valuable, and the nonsuch. Of autumn and winter apples, he considers the Norfolk storer, Norfolk beaufin, lemon pippin, golden pippin, Kentish pippin, William's pippin, cats-head, king of pippins, flower of Kent, Holland berry, Minekin crab, transparent pippin, golden reinette, Biggs' nonsuch, flat green, false beaufin, Minier's dumpling, Padley's pippin, oval apple, and the green Pyramid, to be the most valuable; and enumerates forty other kinds, as highly deserving of cultivation.

Observations.—As none of the different fruits produced in the British isles can be brought to a higher degree of perfection than the apple, it becomes important to acquire a competent knowledge of the habits and constitution of that plant, and this paper by Mr. Biggs communicates the valuable information, that the apple may be raised by cuttings, a mode of propagation which has not been applied to this plant by any other person to our knowledge. If the apple may be propagated in this manner, the same principle perhaps may be applied to the pear and the plum, which would add considerably to the facility of raising fruit trees; and though

these plants do not attain to any great size, and the quantity of fruit they bear, is small in proportion; yet their resisting the canker better than grafted trees, is a very great recommendation, and the ease with which they may be renewed, will probably soon render this the most common mode of propagation. The lists of good apples will be found very useful to any one about to raise an orchard, and also to the planter on the smallest scale; but after all, the principal success will depend in selecting such trees from the nursery as have been grafted from *bearing branches*.

On the Culture and Use of the Cauliflower. By Mr. JOHN SAUNDERS *of Stroud, Gloucestershire.—Dickson's Agr. Mag.* No. 2.

IT is observed that though brocoli and cauliflower are considered dainties, and constantly supply the tables of the great, yet they are seldom cultivated by the cottager, from an idea of their being less profitable than cabbage and other vegetables. An experiment is then related which was made on both white and purple brocoli: Instead of cutting off the whole head, as is the usual practice, Mr. Saunders permitted a part of it, about the size of a gooseberry to remain, together with all the outer leaves, and had the pleasure to behold these little embryo heads gradually expand themselves, so as to form second heads nearly as perfect as the first, and in every respect as sweet and as good eating; and he thus continued managing them till many produced a third, and some few a fourth head. He is certain that cauliflowers may be treated in the same way, and that both will afterwards produce plenty of good seed. The advantages to be derived from this mode of treating cauliflower and brocoli plants, are stated to consist in a supply of these delicious vegetables for two or three months, instead of a general crop, which in ten days or a fortnight, is either all cut or run to seed; and, from the information of a gentleman well versed in horticulture, he recommends that cauliflower and brocoli plants should be planted in the moistest part of the garden, and be treated after the manner of celery.

Observations.—We have much satisfaction in communicating to our horticultural readers, this paper from Mr. Saunders, on the cultivation of cauliflower and brocoli. His advice to plant these vegetables in trenches we cannot recommend, from our own successful experience, and we beg leave to observe that cauliflowers should be planted in much shallower trenches than brocoli. The re-production of heads, from leaving a part of the original, may be expected by reasoning from their analogy to other vegetables of the same class, but we have reason to believe, that though not less excellent for the table, they will be much smaller than the heads of the first crop.

CHEMISTRY AND MINERALOGY.

Chemical Observations; by Mr. de MARTY, *communicated by* Mr. BIOT *to* Mr. BERTHOLLET.—*Ann. de Chim.* No. 183.

MR. DE MARTY has made several observations on the influence of time upon those chemical actions which tend to destroy the elasticity of aeriform fluids.

When oxygen gas is agitated with a small quantity of water, in a close vessel, a small quantity is absorbed; and if the oxygen is left in contact with the water, it continues to be slowly absorbed, so that in upwards of one year the water absorbed half its bulk of oxygen.

The same effect takes place with hydrogen, and even still more visibly, although in two years the water does not absorb its own bulk of the gas. Water which has absorbed oxygen will afterwards absorb hydrogen; and the contrary.

The absorption is in proportion to the quantity of water.

Water absorbs in a single agitation its maximum of azote, which does not continue to be absorbed.

Water charged with azote absorbs oxygen or hydrogen without parting with the azote; a little of the latter escapes at first, but on agitating the mixture, it is again absorbed.

In consequence of these properties, water charged with azote may be used as an eudiometer: it is even sufficient for this purpose to agitate the water with common air, and to leave it for some time exposed to the atmosphere. By this means the water becomes saturated with azote, and the small quantity of oxygen that it absorbs does not hinder it from slowly absorbing by contact the oxygen of the air exposed to it, and leaving the residual azote insulated.

The extract of Mr. de Marty's essay upon eudiometry which was published in the Journ. de Phys. Ventose An IX. was so incorrect, that the author is made to assert opinions directly contrary to his real ones, and these false opinions have been spread by others. Thus Berthollet says in his Statique Chimique, that Mr. de Marty found sulphuret to absorb azote, by its own proper nature, whereas he really said that sulphuret made with heat acts the same as any other liquid which is deficient in the quantity of azote that it can dissolve, and he thus explains the variations which take place in employing different proportions of sulphuret.

By avoiding this source of error, the analysis of air, by means of sulphurets, becomes preferable to that by means of hydrogen, because it requires less apparatus, to which must be added, that if boiled water is employed to confine the gases, some of the oxy-

gen is absorbed by it, and if water saturated with air is used, the force of the explosion always disengages some small bubbles.

Mr. de Marty has also found that the air contained in crowded theatres and churches contained the usual quantity of oxygen: an observation which has also been made at Paris by Gay-Lussac and Humboldt.

Observations.—These facts are directly contrary to the theory of Mr. Dalton, as mentioned in the Retrospect, vol. ii. p. 179; and they can only be reconciled by supposing that the gas unites with the water, or one of its elements, or with the gas that it previously contained, and thus loses its elasticity.

Analysis of the Seeds of Lycopodium. By Mr. Bucholz.—*Ann. de Chim.* No. 183. *From Gehlen's Journ. de Chim.* vi. 5.

The seeds of lycopodium contain 6 per cent of a fat oil analogous to castor oil, and very soluble in water, 3 of sugar, and 1½ of a mucilaginous extract. The remainder consists of a substance which is insoluble in water, alkohol, ether, oil of turpentine, or caustic potash; but by a long boiling with the last, ammonia is disengaged and an extractive matter is formed.

It yields on distillation carburetted hydrogen and carbonic acid gas, also an aqueous liquor charged with acetate of ammonia, and an empyreumatic oil. The carbonaceous residuum resembles anthracite, and is difficult to reduce to ashes.

Moderately strong nitric acid boiled on this substance changes it into a fat oil soluble in alkohol. From all which it appears to be a peculiar organic principle.

Observations.—The semen lycopodii is used by conjurers to sprinkle over the surface of water, that they may dip their hands into it without wetting them, which it enables them to perform by adhering to their fingers and repelling the water. It is also used in theatres to imitate lightning by being flung across the flame of a lighted candle. The lycopodium clavatum or club moss being scarce in England, although it is said to have been found on Hampstead-heath, the seeds are imported from Germany.

On an Antique Vessel, supposed to be Emerald. By Mr. Guyton. —*Ann. de Chim.* No. 183.

This vessel is the sacro catino di smeraldo preserved at Genoa, and which came into the possession of the Genoese, as part of their share of the plunder, at the taking of Cesarea in Palestine, in 1101, and has been esteemed of great value.

Its colour is olive green, darker than that of the peridot, and with a greasy appearance, which brings it nearer to plasma than

to either the green Peruvian emerald or the Siberian beril. Its transparency partakes of this quality. There is a bleb near the centre, and several smaller ones at a little distance.

It may be scratched not only by the emeralds of Peru and Siberia, but even by quartz. This alone is sufficient to shew that it is not a true emerald, but an emerald-coloured glass.

Some further Remarks on the pretended Formation of muriatic Acid in Water by Means of a Galvanic Pile. By Prof. Pfaff.—*Ann. de Chim.* No. 184.

Pure water galvanized in tubes did not afford the least trace of muriatic acid; an acid was indeed produced, but as it was neither the sulphuric, muriatic, carbonic, nor phosphoric, it was probably the nitric. An alkali was produced in the other tube, which was found to be ammonia. From whence we may judge these appearances to arise from the azote in the water combining on one side with oxygen, and on the other with hydrogen.

Observations.—The discoveries of Mr. Davy have fully corroborated the conjectures of Professor Pfaff.

On a Rock in the Monts-d'Or in Auvergne, which contains the Elements of Alum. By Mr. Godon de St.-Memin.—*Ann. de Chim.* No. 183.

In the bed of the d'Or, and in the valley of the same name, there are found fragments of a rock which has the appearance of a breccia. It is ash grey, with whitish spots generally of a parallelogram figure. It sometimes contains lumps of native sulphur and very small crystals of sulphuretted iron. Those which have been immerged in the river, and then exposed to the air, are covered with a citron yellow crust which is white internally.

Its solution in muriatic acid yields, on evaporation, crystals of alum; and hence it appears to be analogous to the alum ore of Tolfa, which it resembles. It was found to contain 66 or 70 of silica, a very variable quantity of iron, sulphur and alumine, and it yielded from $2\frac{1}{2}$ to 3 per cent. of alum.

If the bed from which these fragments proceeded should form a large bed, it might be advantageously worked for alum; notwithstanding it contains pyrites, as the iron they contain would, by the roasting and exposure to the air, be so much oxygenized that it would separate spontaneously from the alum. In effect, it is well known that Roman alum, although very pure, is covered with a crust of ochre arising from the quantity of iron contained in the ore from which it is extracted.

Analysis of Human Excrement. By Mr. Berzelius.—*Ann. de Chim.* No. 183, *from Gehlen's Journ. de Chim.* Vol. 5.

Messrs. Thaer and Einhof gave in the third volume of Gehlen's Journal, an analysis of cow-dung, which occasioned Mr. B. to turn his attention to human excrements.

In health, the excrement has usually the consistence of a thick soap, and its colour varies from a deep green to a yellowish brown, according to the quantity of bile that it contains. Its smell is at first fœtid, but by exposure to the air and heat, it acquires the smell of sour bread, and at length becomes ammonaical and putrid. Its taste is mawkish and bitter, but neither acid nor alkaline.

Diluted with twice its weight of water, it has the appearance of gum-water. On filtering this liquid, there passes a greenish gray turbid fluid, and there is left on the filtre, a brownish gray coarse substance which retains, even after repeated washings with fresh water a disagreeable and peculiar smell. This residuum when dry, resembles toasted bread, mixed with vegetable fibres, and there appears on examination by the microscope, small red and brownish threads of the same kind.

The turbid liquid that passed the filtre, deposits, on standing in a close vessel, a heavy mucilaginous greenish gray substance; without becoming clear. But in a few days, it becomes clear, and a crystalline pellicle is formed of phosphate of ammonia and magnesia in the form of octaedral crystals and others in hexaedral prisms, whose summits are so low that they appear to be round.

The liquor that remains, after the separation of this pellicle yields a liver brown precipitate with the solutions of lead, silver and tin, and a brownish black precipitate with the sulphuric, muriatic and acetic acids. On heating the liquid, the precipitate sticks to the vessel, and the liquid acquires at first the odour of excrement, and afterwards that of bile.

The liquid being decanted becomes red, or violet by evaporation, and leaves a brown extract, which when well dried is almost entirely soluble in alkohol; the residuum leaves on incineration, ashes containng soda, muriate of soda, with traces of the phosphate and sulphate of soda, and of the phosphate of lime and magnesia

The alkoholic solution is brownish red. When evaporated, and the residuum redissolved in water; sulphuric acid separates, when aided by evaporation, a precipitate, which is soluble in alkohol rendering it green. This precipitate resembles that produced by the sulphuric acid, in the water that washed the excrement, as mentioned above.

The solution in alkohol also contains a brownish red substance, soluble in water and alkohol. It is changed to a lively red by acids,

and forms with tannin, a pulverulent red precipitate, which is soluble in alkohol and boiling water. This appears to be formed by the action of the air upon the albumen and bile which it is evident are contained in the excrement.

The substance left on the filtre, Mr. B proposes to call the excrementitial principle. After repeated washing, it remained of a greenish gray, and resembled the nasal mucus. It speedily dries in the air, and becomes covered with a black crust. It dissolves in ether: the solution evaporated to dryness, and the residuum dissolved in water, acquires an aromatic odour, and a taste of pepper. Thus evaporated, it is easily melted, and spreads on boiling water like oil; it leaves a greasy spot on paper, and catches fire like oil. Alkohol only dissolves one part of it, ether dissolves the residuum and forms a green solution which is precipitated by alkohol. This green matter is probably analogous to that found combined with adipocire in calculi. It appears to be composed of altered bile, and another matter soluble in water, insipid and inodorous, which resembles gelatine but does not form a jelly, nor yield a precipitate with tannin.

By drying in a water bath, excrement appears to contain 73$\frac{1}{2}$ per cent. in water; the other principles as far as could be estimated are 0.9 of bile, 0.9 of albumen, 2.7 of a peculiar extractive matter, 1.2 of salts as already mentioned, 7. of insoluble substances, and 14 of a particular animal principle.

While the excrement remains in the intestinal canal, the carbone, phosphorus and sulphur, unite with the hydrogen and form the gases which are discharged by most animals. But when exposed to the air, acids are formed, as also ammonia, and some odorant principles. The smell of excrement and the ease with which it is changed, arises from the bile, for the excrements of persons in the jaundice have very little smell.

To imitate the process of digestion, chewed roast meat was diluted with white of egg beat up with water, and enclosed in a bottle for six hours. The cork then flew out, and the matter run over, some oxgall being now added, the mass in twelve hours acquired the usual smell of excrement, which was increased by the sulphuric and muriatic acids, this smell was succeeded by the smell of bile; concentrated acids changed it to a deep violet.

When oxygenized muriatic acid gas is passed through excrement diluted with water, the excrement becomes white, unctuous and insoluble in water. Boiling alkohol extracts from it a fat substance that melts by heat and leaves a greasy spot on paper. This appears to be occasioned by the alteration of the bile, as that substance may be bleached in a similar manner.

Observations.—The natural repugnance of mankind to the substance here treated of, is such, that nothing but a most ardent desire to extend the boundaries of knowledge could have led Mr. B. to attempt the task of exploring its nature. Avarice, however,

had already excited Homberg to examine it as may be seen in the Mem. of the Acad. of Sciences.

Chemical Observations. By Mr. Berzelius.—*Ann. de Chim.* No. 183.

These observations are contained in a letter to Mr. Vauquelin, dated Nov. 2, 1806. We have already p. 446 published Mr. Berzelius's analysis of bones and teeth, from the Journal de Physique, so that there is no occasion to repeat them here.

Fluate of lime was also found in urine, along with phosphate of lime, both held in solution by disengaged phosphoric acid. The precipitate flung down from urine by lime water, treated with sulphuric acid, yields fluoric acid gas which corrodes the glass but it requires a large quantity of precipitate to observe this effect.

Mr. Gahn has found tantalite and yttrotantalite at Fahlun. By his address in managing the blowpipe, he has found that tantalum is only tin combined with an earth, whose nature he has not been able to determine.

It was at first supposed by the chemists at Upsal, that cerium was only a combination of barytes, yttria and magnesia. Mr. Ekeberg has observed, that yttria after being long exposed to the fire, yields oxygenized muriatic acid gas, when dissolved in muriatic acid. It may therefore be only a masked metal, perhaps uranium, titanium, or cerium. Mr. Gahn has sent to Berzelius combinations of cerium and iron, which are partly metallic, and partly in a grayish powder.

The production of muriatic acid, and soda by the Galvanic pile, from pure water has not been successful in Sweden. Pure water is a bad conductor, and will scarcely discharge the pile; but if there is the smallest quantity of salt contained in the water, the decomposition is very rapid, the positive wire collects the acid, and the negative wire collects the alkali or base. It is therefore probable that the producers of muriatic acid were led into an error by the muriate of soda being contained in the water they used.

Observations.—We have here a confirmation of the justness of our remark on Mr. Davy's paper, that some of the mere facts discovered by him would have naturally arisen from a more careful repetition of the experiments. We may further remark that we are glad to find the Swedish chemists retain their accustomed accuracy and acuteness, and thus anticipated the French and Italian chemists in respect to the pretended production of muriatic acid and soda, although the latter approached so near to the truth, that we cannot but wonder at their missing of it.

On the Decomposition of Acetate of Barytes, by means of Soda. By Mr. D'Arcet —Ann. de Chim. No. 183.

In Mr. Perpérès's paper on the formation of acetous acid in the stomach, when things do not digest properly, (see p. 302), he mentions that having saturated the acetic acid with pure soda, he afterwards decomposed the acetate by barytes; to this he adds, that having thus set the soda free, he added alkohol, which seizing the water of the solution, precipitated the acetate of barytes, that had been formed. In this passage he seems to have committed an error.

If a hot and saturated solution of barytes in water is added to acetate of soda, a precipitate in small brilliant laminae is formed, but it is no other than pure barytes; for when it was exposed to the air, for some days, and then washed, the ley did not yield a precipitate by either sulphuric acid, or the alkaline carbonates, or sulphates. The precipitate also being dissolved in water, restored the colour of litmus paper, which had been reddened by an acid; and on sulphuric acid being added to the solution until it shewed a slight excess of acid, no signs of any barytes remaining in the solution could be observed.

The mother water ought therefore to contain only that portion of barytes, which the water can contain in solution, together with all the acetate of soda, that had been formed. If therefore alkohol is added as indicated by Mr. Pérpères, the brilliant crystals that fall down are only pure barytes, while the residual liquor contains scarcely any barytes, and much acetous acid, particularly if it is evaporated to dryness, and the residuum dissolved in water, as it then contains only acetate of soda, the carbonate of barytes formed by the action of the atmosphere being separated.

So far from barytes decomposing acetate of soda; the fact is that soda decomposes the acetate of barytes. Mr. Darcet had already shewn, along with Mr. Anfrye in the Ann. de Chim. for the year XII. that it is only in respect to the sulphuric and carbonic acid, that barytes takes place before potash and soda. Indeed nitrate, muriate and acetate of barytes, are so easily decomposed by potash and soda, that the most economical mode of preparing barytes is to calcine ponderous spar with charcoal. Then mixing it with water, to add either nitric, muriatic, or acetic acid, which disengages sulphuretted hydrogen, and carbonic acid gas. As soon as the liquor contains an excess of acid, it must be filtered, and evaporated, to separate the sulphur that is formed; or a few drops of nitrate of lead, or nitrate of copper may be added, and the sulphuretted metal afterwards separated by filtration. The residuum is to be dissolved in the smallest possible quantity of water, and a saturated solution of caustic potash added, which throws down a

great quantity of barytes. After exposing the liquor to the coldest temperature that can be obtained, the mother water is to be decanted.

In this process, muriatic or acetic acid is preferable to the nitric, because the nitric acid oxygenizes a part of the sulphuretted barytes, and thus the sulphate of that earth is reproduced.

The potash ought to be carefully freed from sulphuric acid; it may be rendered caustic by the method of Descroizilles, see p. 170.

On the Combination of Fixed Oils, with the Oxides of Lead, and the Alkalies. *By* Mr. F. Fremey.—*Ann. de Chim.* No. 184.

Scheele announced that the water, which served as an intermedium, when oils, or lard were treated with litharge, retained a sweet substance in solution, which he called the sweet principle of oils: but as the water also contained some of the oxide of lead, a doubt may be started, whether the sweetness did not arise from the union of the metal.

Equal parts of olive oil, litharge and water, were boiled in a tubulated retort, and stirred by means of a spatula introduced through a bladder attached to the tube of the retort. The oxide changed from red to yellow, and afterwards to white; carbonic acid gas was disengaged during the whole process. The water acquired a strong metallic taste. It did not ferment, on yeast being added to it. It was precipitated by sulphuric acid, and the hydroguretted sulphurets. Sulphuretted hydrogen passed through it, separated sulphuret of lead, the supernatant liquor had a strong saccharine taste.

On evaporating this liquor to the consistence of a syrup, and adding acetate (superacetate) of lead, no sulphuretted hydrogen appeared to be retained in it, nor would it ferment; it attracted the moisture of the air; flung on burning coals, it took fire like oil; boiled with the different oxides of lead, it only united with the yellow oxide. Nitric acid abstracted from it, produced the oxalic. On distillation, a part of it came over, and it afterwards yielded empyreumatic oil, acetic acid, carbonic acid, carburetted hydrogen, and a spongy light charcoal, which did not contain oxide of lead.

To separate the oil which had combined with the oxide of lead, acetic acid was employed, on account of the solubility of the salt of lead that is formed. The oil thus separated has the consistence of lard, and smells like rank lard. It is insoluble in water, but it is much more soluble in alkohol than the other fat oils, and it may be separated from the alkohol by water. Some part of it rises in distillation. It readily unites with white oxide of lead, and forms a solid plaister-like mass, which is not the case with litharge or massicot. The yellow and white oxides of lead, cannot be com-

bined with the common oils, like litharge. It is not of any consequence whether the oil be rancid or not.

From the preceding facts, it appears that it is only when fat oils are made to approach to the nature of volatile oils, that they can be united with white oxide of lead.

Plaisters having been esteemed a kind of metallic soap, the union of fat oils with alkalies was examined. Soap lees was mixed with olive oil, and left under a jar of air. In six weeks time, the absorption of the air was complete, and the soap was made. Diluted sulphuric acid separated carbonic acid gas, and the oil resembled that separated from plaisters, being easily soluble in cold alkohol, and separable by water. In making soap in the usual way, on sweet principle could be discovered in the residual ley; the softness of soap made with potash does not depend on the state of the oil, for it was equally soft when made with oil separated from hard soap.

On the most sensible Tests for Muriatic Acid, Carbonic Acid, Sulphuric Acid, and Ammonia. By Prof. C. H. Pfaff.—*Ann. de Chim.* No. 184.

Nitrate of silver has generally been used as the best test for muriatic acid, but the nitrate of quicksilver ad minimum prepared in the cold is still better. One part of muriatic acid, whose specific gravity was 1.150 mixed with 70000 parts of water, was rendered slightly opaline by nitrate of silver; with 80000 of water the nitrate of silver had no perceptible effect, but the nitrate of quicksilver ad minimum rendered it very sensibly turbid; even with 100000 of water, a slight opales cent tinge was produced.

The same nitrate is also the best test for ammonia; 1 part of ammonia iu 30000 of water was shewn by a slight yellow black tinge.

Lime water, or barytes water is generally considered as the most sensible test for carbonic acid, but acetate of lead is superior. Kirwan considers acetate of lead as deceitful, because, he says, it sometimes is rendered turbid by distilled water; but this only takes place when the water contains carbonic acid. Water very carefully distilled, and free from carbonic acid was not affected by either lime water, or acetate of lead, but on adding a few drops of carbonic acid, although lime water was not affected, and litmus paper was not reddened, yet acetate of lead produced a sensible whiteness.

Acetate of lead is not so sensibly precipitated by other acids. 1 part of sulphuric acid, of the specific gravity of 1.850 diluted with 16000 of water, acted sensibly upon litmus paper, but did not render acetate of lead turbid. On the other hand, barytes water is precipitable by 1 part of sulphuric acid with 70000 of water.

Nitrate of quicksilver ad minimum is equally efficacious for phosphoric acid, as for muriatic acid, but the precipitate in the first case is soluble in an excess of phosphoric acid, while the muriatic precipitate is not soluble in an excess of any acid.

Observations.—By the acetite and acetate of lead here mentioned, we are to understand what is now called super-acetate of lead, the name being, as all the new names must be, altered according to the progress of chemical knowledge, which shews the inconveniency of using a systematic nomenclature, in relating experiments, although nothing can be better adapted for explaining the theory of processes. The salt here meant is the well known substance called sugar of lead in the shops. Its precitability by water containing carbonic acid had been already noticed by Proust.

We have translated the term nitrate de Mercure doux, by nitrate of quicksilver ad minimum, not only to preserve an uniformity with Mr. Proust's papers; but also because the other could not well be rendered literally.

On Examining Glass, and particularly Plate Glass, so as to distinguish that which will be subject to alteration. By Mr. Guyton.—Ann. de Chim. No. 184.

The defects which are so frequently found in window-glass, not only destroy its transparency, but are disagreeable to the eye, so that it would be very desirable if a method could be discovered of knowing beforehand, whether any particular specimen of glass was likely to have the defects.

The specific gravity of glass is so much increased by lime, and the metallic oxides, that nothing certain can be deduced from it. Some white glass whose specific gravity was 2.38, resisted the most powerful acids, while black glass whose specific gravity was upwards of 2.73 was attacked.

The grain of the glass yields only mere conjectures; Mr. Duclose says, indeed, that the grain of good glass is always wavy, and its angles more or less sharp, but there is frequently more difference between the fractures of the same glass than between those of different specimens of glass.

The hardness of glass is very various; workmen distinguish with ease that which is easily cut by the diamond, and that which is eager. But it is very difficult to obtain a precise value of the different degrees of hardness; the mineralists who have bestowed the greatest attention to this character have found that they can only place bodies in the order in which they are scratched one by another. The harder stones scratch the most perfect glass, and therefore they cannot afford any assistance in judging of the quality of glass unless by the different depth of the scratch.

Immature asbestus, zeolite and tremolite are the only stones that operate unequally upon different species of glass; and cut the glass that is altered speedily easier and deeper than perfect glass; but this trial is uncertain. The sharp edges of glass, as also those of rock crystal, will scratch the flat surface of the very same substance, and as these traces are deeper on the softer kind of glass, it may be useful to observe what impression the angles of a good specimen of glass make upon the glass to be tried, in comparison with that which it makes on its own surface.

It is known that inferior glass is a bad insulator of electricity, and can scarcely be excited by friction. The better kinds of glass are easily excited by being rubbed on a piece of cloth, notwithstanding they contain metallic oxides, so that this property may be sometimes employed to form a judgment of a specimen of glass.

Inferior glass is very easily altered by fire; when put upon burning coals it becomes dull, and more or less powdery in the surface, this alteration is still more sensible when a blow-pipe is used. But a long continued heat will render the most perfect glass opake; and by using proper precautions, inferior glass may be refined before the blow-pipe, so as to become clear.

The solutions of the alkaline and earthy muriates only act, by being boiled, upon these kinds of glass, which are so very inferior in other respects, as to require no examination; but common window glass, although in general of a good quality, was sensibly changed on its surface, by being boiled with a solution of alum and common salt.

Most specimens of glass when reduced to powder, are affected by concentrated acids; but while the glass continues solid, the sulphuric acid does not act upon the better kind of glass, while the very inferior kind is corroded, and there is formed white silky tufts formed of the acid united with the earths in the glass. Other specimens of glass, although alterable by the air, require the acid to be assisted by a heat sufficient to raise it into vapours, and then none but the more perfect kinds of glass can resist this agent, which is in fact a very proper proof liquor for glass. As however some persons may object to the danger of employing this acid, the sulphate of iron may be employed in its stead. The plates of glass may be placed in a Hessian crucible, and covered with grossly powdered sulphate of iron, and thus exposed to the fire till the salt becomes red; then after cooling the crucible, the glass must be plunged in water, by which means the degree of alteration in the glass may be ascertained.

Observations.—We should prefer the use of the pure sulphuric acid, in preference to the sulphate of iron, as being simpler in its operation, and requiring a less legree of heat.

Analysis of Siderite, or Lazulite. By Messrs. TROMMSDORFF *and* BERNHARDI.—*Ann. de Chim.* No. 184, *from Gehlen's Journ. de Chim.* 1. 2.

THE lazulite was first discovered in Stiria, and afterwards in Saltzburg; this latter was first denominated mollite, but Baron Moll himself called it siderite.

Klaproth examined lazulite, and found silica, alumine and iron; but could not discover the proportions. Heim stated siderite to contain 65 per cent. of alumine and 30 of iron.

Lazulite has only a slight analogy to felspar.

The most common form is a regular octaedron with truncated edges, which passes to a regular rhomboidal dodecaedron. The planes of the octaedron make an angle of 109° 28′ 16″; those of dodecaedron 120°; and the first cut the others under an angle of 144° 44′ 18″. There are several smaller faces which cannot be easily discerned. Sometimes siderite is found in prisms of 101° 32′ and 78° 28′, at the extremity of which there are several indeterminate faces. The cleavage is imperfect.

Its crystallization is analogous to that of spinelle, and its composition is somewhat similar, for the calcined lazulite, contains 66 per cent. of alumine, 18 of magnesia, 10 of silica, 2 of lime, and 2¼ of oxide of iron. From whence we may infer that spinelle and lazulite are the same species, and that alumine combined with magnesia are the essential ingredients of the species.

It lost 5 per cent, by being ignited, and its blue colour was changed to a yellowish white.

The blue colour seems to depend on the oxidizement of the iron, especially as Ritter has announced the existence of a blue oxide of iron. That it does not depend upon Guyton's blue sulphuret of iron is evident from its not containing the least trace of sulphur or sulphuric acid.

Observation on Phytolacca decandra; called by the French, Raisin d'Amerique. By Mr. BRACONNOT.—*Ann. de Chim.* No. 184.

PHYTOLACCA decandra grows naturally in Virginia, Spain, and Portugal. It is also found naturalized in the coppice woods, near Pont a Mousson in Lorraine.

This acrid plant has a root as thick as a man's thigh, with purple stems like walking-sticks, 6 or 7 feet high. Pieces of these stems exposed to the flame of a taper, yield a melted frothy mass of potash.

4400 decigrammes (13¾ oz. Troy) left, on being burnt, a brown, hard, acrid frothy mass, which after elixiviation and eva-

poration left 280 decig. of saline matter. This saline matter was saturated with nitric acid, and deposited 4 decig. of Prussian blue holding some silica. The nitric solution did not yield any precipitate on adding nitrate of strontian; but nitrate of silver flung down 22 decig. of muriate of silver. Sulphuretted hydrogen was then added to separate the silver that remained, and the remaining solution yielded 330 decig. of very pure nitrate of potash.

The residuum that was left on elixiviation, dissolved with effervescence in nitric acid and left 4 decig. of silica. The nitric solution was evaporated to dryness, to decompose the nitrate of iron, and then being again elixiviated, the residuary oxide of iron was neglected, as the plant had been burnt in an iron crucible.

Caustic ammonia threw down 4 decig. of a precipitate soluble in nitric acid. This nitric solution was not precipitated by nitrate of lead, or prussiate of potash. Oxalic and sulphurie acid threw down a slight precipitate.

The liquid that had been precipitated by ammonia, yielded 130 decig. of carbonate of lime, by the addition of carbonate of potash; and the supernatant fluid deposited a few decig. of the carbonates of lime and of magnesia by ebullition.

It is probable that the lime found in the residuum, and the potash in the ley, were in the recent plant saturated with some acid.

It appears, therefore, that a cwt. of phytolacca ashes, would produce 66lb. $\frac{3}{4}$ + of nearly pure carbonate of potash, containing about 42lb. of pure caustic potash; and it is probable that more might be obtained by burning the phytolacca in an earlier stage of its growth.

4500 decigrammes (14 oz.) of the stems of phytolacca were boiled in water; the decoction did not change the colour of tincture of litmus. When evaporated to a syrop, it yielded 10 decig. of salt in confused crystals. On elixiviation this salt left $2\frac{1}{2}$ decig. of white powder, soluble in nitric acid, the solution being precipitable by nitrate of lead. The ley did not crystallize, but left a saline crust on evaporation.

This salt threw down a white precipitate, insoluble in distilled vinegar, from lime-water, and the nitrates of lime, strontian and lead. It left carbonate of potash, on being incinerated.

The decoction of phytolacca evaporated to a syrop was diluted with water, and nitrate of lead being added, flung down a precipitate weighing 50 decig. the supernatant liquor yielding nitrate of potash. The precipitate was treated with diluted sulphuric acid, which produced a smell of urea, and on being filtered, the clear iquor did not crystallize by evaporation, but left a yellowish adhesive, deliquescent substance, reducible to a coal by heat.

This acid occasioned a precipitation in nitrate of lead, the precipitate was, by the blowpipe, instantly reduced to lead. It did not precipitate the nitrate of lime, or of strontian, unless united with ammonia. It precipitated lime-water, the precipitate was

reduced to a coal upon a hot iron, and it then dissolved with effervescence in nitric acid. When saturated with soda, it did not crystallize by evaporation; the compound being heated, left a light alkaline charcoal, effervescing strongly with nitric acid.

The *phytolaccic* acid appears to partake of the nature of the malic and oxalic acids, but mostly of the former, from which, however, it differs as the combinations it forms with lime and lead are insoluble in distilled vinegar. If on further examination, it should be found to be only malic acid, it will be the first example of malate of potash being found native.

The berries of phytolacca were bruised with water, the liquor being filtered had a most beautiful purple colour, which is of no use in dyeing from its great alterability. The juice of the berry is sweet, but leaves an acrid taste in the mouth. It changes litmus paper red; but a little hot water restores the blue colour. It ferments very rapidly, the wine is disagreeable, but yields brandy on distillation.

A few drops of lime water changes the purple colour of phytolacca juice to a fine yellow; the least drop of acid restores the purple, even breathing through it has that effect, on account of the carbonic acid expired. If the yellow liquor is used for writing, blowing upon the paper will change the colour; which is also done, but slowly, by exposure to the air. Sulphuretted hydrogen and urine also restore the purple colour. The yellow colour is rendered brighter by water, and takes a tinge like chromate of potash. A larger quantity of water restores the purple. This does not depend upon carbonic acid, for water that has been boiled has the same effect; it is therefore probable that the water diminishes the effect of the lime. In like manner, green sulphate of iron added to infusion of galls does not form ink; but, when the mixture is diluted with water, the action of the sulphuric acid upon the iron is weakened, and ink is formed.

This yellow liquor is an excessively sensible test for acids. On a comparative experiment with tincture of litmus it appeared to be four times as sensible: but the colour is so fugacious, that it can only be employed immediately after it is prepared. In a few hours it deposits a fawn colour precipitate, which viewed in the sun exhibited an opaline appearance: in a few days brown flakes fell down, and the liquor became colourless.

The purple liquid treated with pure alkalies assumed a yellow colour. With the alkalinulous carbonates, (subcarbonates) a fine violet which changed to a yellow. With diluted acids, nothing particular. With weak oxygenized muriatic acid, a loss of colour, and white flakes. With alum, no alteration at first, but a very light red precipitate in a few days. With muriate of lime, no alteration. With muriate of tin, a red precipitate verging to lilac colour, the supernatant liquor lost its colour. With nitrate of lead, a precipitate of the colour of wine lees. With sulphate of superoxydized iron, (green sulphate) a dirty violet colour; the addi-

tion of an alkali threw down a very deep green precipitate which became yellow in the air.

The purple colour of the external covering of the stalks is similar to that of the berries.

This purple is not formed by the alteration of some other colour; for, on changing it to yellow, by very pure ammonia, and dyeing cloth with this bath, the cloth became purple as the ammonia evaporated.

It differs from other purples; for the red of plums and cherries is changed to a green by the alkalies, and that of litmus becomes blue. The colouring matter of grapes appears however analogous to it; for lime water added to red wine, throws down a yellow precipitate that changes to red by an acid. The Portugueze used the berries of phytolacca to colour their wine; but, as they employed too much of them, the taste was deteriorated, and the plants were ordered to be destroyed.

This plant has only been cultivated hitherto as an ornament. The North Americans however use the young shoots as a spinage herb. Parkinson says they also use the juice of the root as a purgative, the ordinary dose being two spoonfulls. But it would be advantageous to cultivate this plant in large quantities, by sowing it in the spring, and transplanting it where it might stand for several years, as it is perennial in root. The large stems might be used for fuel, the ashes want only melting to be sold as potash, the leaves are edible, and from the berries might be produced either vinegar or ardent spirits.

A new Eudiometer, accompanied with Experiments, elucidating its Application. By Mr. W. H. Pepys.—*Philosophical Transactions, for* 1807. Part II.

This eudiometer is composed, 1. Of a glass tube, or measure capable of containing a cubic inch of water, and divided into 100 parts. 2. A gum elastic bottle of about 2 cub. in. capacity, to the neck of which is secured by waxed thread, a bent perforated glass stopper, that is ground so as to fit into the mouth of the measure. 3. Another very small gum elastic bottle, in the neck of which is secured a small steel cock; to the other end of this cock is cemented a small glass tube with a small aperture at the other end which is conical. This tube is graduated into thousandth parts of a cubic inch 4. A large tube or small cistern open at both ends, dilated at one extremity, and contracted at the other, into this is inserted a perforated cork through which the small tube passes, and may be moved up and down without letting the water or other liquid in the large tube pass. 5. A pair of forceps to hold the larger graduated tube that its temperature may not be altered by the hand.

These three tubes are nearly of the same length, and they are

thus used. The measure is filled over quick silver with the air to be examined; and the elastic bottle, No. 2, is filled with the solution to be employed as the reagent, and the orifice of the stopper being inserted into the mouth of the tube, the elastic bottle is pressed, to throw the liquid up into the measure. When the absorption ceases, the elastic bottle is separated from the measure under quicksilver, and the measure is removed into the small cistern, which is filled with quicksilver. Slide the small graduated tube up so as its orifice may be above the surface of the fluid in the measure, and then, opening the steel cock, permit the quicksilver in the small tube to descend until it has drawn the fluid in the measure to a regular division. The cock is then to be closed, and the centesimal parts are to be registered; the fluids on the inside and outside of the measure being brought to a level, by increasing or diminishing the quicksilver in the cistern, the millesimal fractions may be taken from the small graduated tube.

Atmospheric air was tried with a solution of green sulphate of iron impregnated with nitrous gas, and by a gentle injection .215 were absorbed. If the experiment was made hastily, the impregnated solution loses a portion of its nitrous gas, which must be abstracted by a solution of green sulphate of iron.

For ascertaining the purity of nitrous gas, the elastic bottle may be charged with the solution of green sulphate of iron, or muriate of iron.

For carbonic acid gas, with lime or barytic water.

For oxygen, with the solution of green sulphate of iron impregnated with nitrous acid.

For sulphuretted hydrogen gas (obtained from sulphuret of potash by diluted muriatic acid) with a solution of nitrate of silver, which takes a black flocculent appearance, and absorbs the greatest part of the gas, .005 only being left.

This instrument may also be applied to the analysis of the mixed gases.

Carbonic acid gas may be freed from sulphuretted hydrogen, by a solution of the nitrates of silver, or of quicksilver employed hot, as the acid gas is absorbed by the water of solution, at the ordinary temperature.

Carbonic acid gas may also be freed from nitrous gas by a hot solution of green sulphate of iron.

Previous to the discovery of these methods, it was found that 100 of alkohol absorbed 70 parts in volume of carbonic acid gas, or of sulphuretted hydrogen gas.

Alkohol impregnated with sulphuretted hydrogen precipitates the solutions of the nitrates of lead, silver, and quicksilver of a dark brown colour.

Nitric acid of the specific gravity 1.4. or 1.25. absorbs carbonic acid gas, without undergoing any change. It also absorbs sulphuretted hydrogen, which occasions a slight milky cloud in it.

The solutions of nitrates of barytes, strontian and lime absorb

half their volume of carbonic acid gas, without any apparent alteration. The same solutions absorb 6-10ths of their volume of sulphuretted hydrogen gas with a slight change of colour. These impregnated solutions precipitate the solutions of nitrates of quicksilver and of silver, and of acetite (superacetate) of lead, of a dark brown colour, and might, of course, be useful for reagents. The acetite (superacetate) of lead whether hot or cold is decomposed by carbonic acid gas, carbonate of lead being precipitated.

Carbonic acid gas is absorbed by the solution of green sulphate of iron, if the temperature be under 100°. fahr. If the solution is about 180°. fahr, it does not absorb the gas.

Eighty per cent. of nitrous gas is absorbed by a solution of sulphuret of pot-ash, sulphur is, at the same time, precipitated.

Nitrous gas is also absorbed by the solution of nitrate of copper, without any peculiar alteration.

The air remaining after combustion may be examined first with limewater, which will absorb the carbonic acid gas; and then, as above stated for atmospheric air. Or one part being examined with limewater, another part may be treated as for atmospheric air.

When the separated gases are liable to be absorbed under certain temperatures, or where a new series of reagents are to be employed, or if the depositions on the tubes would induce errors, it will be proper to transfer the residual gas.

To do this, fill the small bottle and tube with quicksilver, and let the tube rise a sufficient heighth within the measure, as it stands in the cistern, press the quicksilver out of the small bottle, and then letting the elastic bottle extend itself, it will withdraw the gas from the measure. Care must be taken that the cock is stopped in time to prevent any of the solution from entering the tube. If now the opening of the tube is sufficiently small, it may be drawn down into the quicksilver, without any of the gas escaping, while the measure is dried, or cleaned, or a fresh one filled with quicksilver applied.

In other cases, the solution employed as a reagent may be withdrawn, by filling the larger elastic bottle with quicksilver, joining it to the measure, and simply inclining the latter, that the quicksilver may by its gravity replace the solution.

Observations.—This is a very ingenious contrivance, and may be of great service to those gentlemen whose fortune permits them to adopt the use of such physico-mechanical conveniences in their chemical studies. The true chemists may object to it on account of its complication, and as tending to render unnecessary that manual dexterity in the use of simple instruments which it is of the utmost importance to acquire.

We cannot pass over this paper without noticing the great want of arrangement, which is so very observable in the progress of it; and which we did not expect from the commencement, and still

less from the methodical distribution of the author's other paper, in conjunction with Mr. Allen, on carbonic acid and the diamond, which immediately follows.

On the quantity of Carbone in Carbonic Acid, and on the Nature of the Diamond. By Messrs. Allen, *and* W. H. Pepys.—*Phil. Trans. for* 1807. Part II.

Lavoisier had stated carbonic acid to contain 28 per cent. of carbone; but the experiment of Guyton, on the combustion of the diamond had led most chemists to adopt his statement of 17.88 per cent. of carbone.

The apparatus used in these experiments was composed of two mercurial gazometers connected by a tube of platina, containing a tray of the same metal in which the substances operated upon were placed, while oxygen was repeatedly passed over them from one gazometer to the other. The platina tube was connected to the gazometers, by glass tubes, and was heated to redness by being passed through a small furnace.

The purity of the oxygen, which was always obtained from hyperoxygenized muriate of pot-ash, was ascertained, by the use of a solution of green sulphate of iron impregnated with nitrous gas, and when the diminution had arrived at its maximum, and the gas began to increase in volume, the simple solution of the sulphate was employed, which absorbed the nitrous gas that had escaped from the impregnated solution. This oxygen never gave the least trace of carbonic acid; and was prepared afresh for each experiment as it was sensibly deteriorated by keeping, even in stoppered bottles.

Different woods were reduced to charcoal under sand; and the charcoal exposed to the air for a week. The greatest increase of weight took place in an hour or two, and arrived at its maximum in less than 24 hours.

Woods.	Weight. Grains.	Charcoal. Grains.	Absorption. Per Cent
White fir	300	54½	13
Lignum vitæ	800	138	9 6-10ths
Box	400	81	14
Beech	500	75	16 3-10ths
English oak	250	43½	16½
Mahogany	200	31½	18

Charcoal *confined* in common air increased but very little in weight. And on heating the charcoal that had been exposed to the open air it yielded such a quantity of water as to shew that the increase of weight was principally owing to that fluid.

21 cubic inches of carbonic acid gas, at the temperature of 44° Fahr. and the barometer at 29.86 inches, weighed 10.2 grains:

and the same quantity of oxygen leaving a residuum of 2 parts in 100, weighed, at the same temperature and pressure, 7.3 grains.

Thermometer at 42° Fahr. barometer at 30.2 in. Four grains of boxwood charcoal (weighed while red hot) were exposed for 6 or 7 minutes to the action of 49.84 cubic inches of oxygen containing 3 per cent. of azote. The tube became white hot, but not the least flash of light was observed, nor any moisture, ,02 gr. of white ash was left, the volume of gas was not altered; but lime water absorbed 56 per cent. of it, the tests for oxygen absorbed 41, and a residum of 3 per cent. was left.

Therm. 56°. barom. 30,20. Nine Brazil diamonds weighing 3.95 grains, were exposed for 10 minutes to 49.84 cubic inches of oxygen of the same purity as before. The tube did not become white hot, nor was there any appearance of moisture. There were no ashes, or discoloration in the tray, but some of the diamonds were reduced to a minute speck, and all resembled opake white enamel. They weighed 1.46 grain. The volume of the gas was not altered, but lime water absorbed 36 per cent. of it, the tests for oxygen absorbed 60, and a residuum of 4 per cent. was left.

Therm. 48° barom. 30.08. Eleven diamonds weighing 4,01 gr. were exposed for a quarter of an hour to 49,84 cubic inches of oxygen of the above purity. Not a vestige of the diamonds were left; the volume of the gas was unaltered; but lime water absorbed 57½ per cent. of it, the tests for oxygen absorbed 39½ and a residuum of 3 per cent. was left.

The precipitate in lime water appeared denser than that flung down by the gas obtained from the combustion of charcoal; 20½ cub. in. of gas precipitated 12 gr. of carbonate of lime dried at 212° Fahr.

Therm. 57° barom. 29.65. Four grains of the coak made from Welsh stone-coal were exposed for about ten minutes to 49.84 cubic inches of oxygen containing 5 per cent. of azote. A flash seemed to appear when the gas first passed. ½ a grain was unconsumed. The volume of the gas was not altered, lime water absorbed 53 per cent. of it, the tests for oxygen absorbed 39, and a residuum of 8 per cent. was left.

Therm. 44½, barom. 29,94. Four grains of plumbago were exposed for a quarter of an hour, to 49.84 cubic inches of oxygen containing 2 per cent. of azote. .2 of a grain of oxide of iron was left. The volume of gas was not altered, lime water absorbed 55 per cent. of it, the tests for oxygen 42, and a residuum of 3 per cent. was left.

Therm. 60° barom. 30.23. Four grains of the black shining coal left on distilling muscular fibre were exposed for 8 minutes to oxygen containing 2 per cent. of azote. The first time the gas passed, a lambent flame filled the glass tube, and the gas became turbid. A minute portion of charcoal and some saline matter remained, but it adhered so firmly to the tray that it was obliged to

be abandoned. The gas was not altered in volume, lime water absorbed 40 per cent. of it, the tests for oxygen 54, and a residuum of 6 per cent. was left.

Therm. 59° barom. 29.45. Four grains of the same coal of muscular fibre, but which had been heated under sand, were exposed, for about 8 minutes, to 49.84 cubic inches of oxygen containing 2 per cent. of azote. Flashes like lightning ran along the glass tube 5 or 6 times, and the gas became turbid. The tube became white hot, the tray contained a mixture of salts weighing ,8 of a grain; the internal parts of the gazometers were very slightly covered with a sort of efflorescence. The volume of the gas was not altered, lime water absorbed 41 per cent. of it, the tests for oxygen 55, and a residuum of 4 per cent. was left.

From these experiments it may be concluded that 100 grains of carbonic acid contains 28.60 of carbon, which does not much differ from the statements of Lavoisier and Smithson Tennant. Diamond also appears to be pure carbone, for it neither detonated with oxygen, nor diminished the quantity of oxygen. Well-burnt charcoal seems also to contain no sensible quantity of hydrogen; but if it be exposed to the air for some time, it absorbs moisture, which renders the results uncertain. Charcoal cannot be an oxide of carbone; for it requires as much oxygen for its combustion as diamond: this is also the case with stone coal and plumbago, whence it appears that the diamond and the other carbonaceous substances differ principally from each other in the state of aggregation of their particles, and from thence arises the variety of temperatures required for their combustion.

Observations.—These physico-mechanical experiments are an extension of the chemical experiment of Messrs. Desormes and Clement, with a more elegant apparatus than they used. The experiments were evidently conducted with great care, but we are surprized that the authors did not attend to the excess of the residuum in some of the experiments, especially as the excess was observed when coak and animal coal were employed, and thus affords an argument for the animal origin of mineral coal. In respect to the existence of hydrogen in diamond, all that can be legitimately inferred is, that carbonic acid gas, and the carburets called charcoal, animal coals, plumbago, &c. contain the same ponderable element or combination of elements as the diamond; and therefore if diamond contains hydrogen, it must also be contained in the other substances, and in the same proportion.

It will follow from these experiments that carbonic oxide gas, instead of being composed of 26 per cent. of carbone. and 74 of oxygen as stated by Dr. Thomson, is in fact a combination of 40.58 per cent. of carbone with 59.42 of oxygen.

On the Tartarite of Lime contained in acidulous Tartarite of Potash. By Mr. Destouches.—*Ann. de Chim.* No. 182.

From a few experiments made by him Mr. D. concludes that the quantity of tartarite of lime contained in the tartarous acidule (cream of tartar) is variant. The proportion rises from almost one-third to 7 per cent. but does not exceed that quantity.

Tartarite of lime is soluble in 600 parts of boiling water, and is capable of being crystallized, by being mixed with a more soluble tartarite.

In order to separate all the tartarite of lime that the tartarous acidule contains, when tartarite of potash-and-soda (Rochelle-salt) is prepared, the liquids ought to be cooled before the precipitate is separated.

The most simple method to analyse the tartarous acidule, in respect to the tartarite of lime, is to treat it with carbonate of soda in 5 or 6 times its weight of boiling water, to cool the solution, and to wash the precipitate with boiling water.

NATURAL PHILOSOPHY, ARTS, AND MANUFACTURES.

On Fairy-rings. By W. H. Wollaston, *M. D. Sec. R. S.*—*Philophical Transactions for* 1807, Part II.

Those circles or rings of dark green grass, that are frequently observed on old pastures, are commonly known by the name of fairy-rings. The substance of this paper is reducible to the following observations made by Dr. Wollaston during a few years of residence in the country, on the formation and progressive changes of those rings or circles.

1st. He always observed certain fungi growing upon each of those rings, when it was examined at a proper season. In the case of mushrooms he found them to be *solely* at the exterior margin of the dark ring of grass. The breadth of the ring measured from them in a direction towards the centre was *about* twelve or fourteen inches, whilst the mushrooms themselves covered an exterior one *about* four or five inches broad. This circumstance attending the position of the mushrooms, led him to conjecture, that the ring was probably formed by a gradual or progressive increase from a central point, a fact however, which he allows to have been distinctly noticed by Dr. Hutton in his "observations on certain natural appearances of the ground of the hill of Arthur's seat," in the Transactions of the Royal Society of Edinburgh. He supposed that the soils, which had once produced a crop of fungi, might be thereby so exhausted as to be incapable of producing a second one; that the succeeding years crop

of them would of course appear in a small ring round the original centre of vegetation, but farther from the same; and the new roots from want of nutriment on the side nearest to the said centre, would necessarily extend themselves outwards, and unavoidably occasion an annual enlargement of the ring.

2d. The remark of Dr. Withering, that "on digging up the soil to the depth of about two inches, he never found any of the spawn of the fungus existing, where the grass had again grown green and rank is not founded on observations sufficiently accurate, as the grass may at some period be found luxuriant, even over the undecayed spawn.

3d. If, when the ring surrounding the dark one appears bare of grass through the absorption of the nutriment by the fungi, a transverse section be made of the soil beneath the rings, the part thereof under the fungi appears paler than the soil on each side of it; whereas that, which is beneath the interior circle or ring of dark grass, is found to be considerably darker than the general surrounding soil.

4th. The section of the space occupied by the whole spawn of the fungi, has in general nearly the form of a wave proceeding from the centre outwards, as its boundary on the inner side ascends obliquely towards the surface while on the outside it has almost a vertical termination.

5th. On marking various circles for three or four years successively by incisions of different forms he found the annual enlargement of them to vary in different ones, from eight inches up to two feet, or that of some of them to be thrice as great as others.

6th. Whenever two adjacent circles or rings were found to interfere, he observed in more than twenty cases, that they not only did not cross each other but that they were both of them invariably obliterated between the points of contact, which circumstance he regarded as a confirmation of his theory of their formation.

7th. That in one instance he found that a circle, which had been interrupted in its regular progress by a tree, had extended itself at the usual rate, passing obliquely on each side of the tree, into the soil beyond it, and giving the ring the form of a kidney, a circumstance which led him to suppose, that in a year or two the extremities of it would unite and form a ring quite round the tree.

Observations.—Dr. Wollaston allows, that Dr. Hutton took notice distinctly of the progressive enlargement of the fairy-rings or circles, without attempting to assign the cause or causes thereof; but that Dr. Withering ascribed it to its true cause; namely, the growth of agaric. From these data the transition was simple and easy to his theory, which after all rests only on probability, and not on certainty. And it must be acknowledged, that it is only a branch of a more general theory, well known to farmers and others; for it is in the nature of all weeds capable of destroy-

ing herbage to extend themselves progressively from the central points in meadows, where they first take root and spring up.

The Dr. seems to be fully sensible that fairy rings are in themselves of no importance.

Transformation of Mr. Dubuat's Hydraulic Theorem. By Thomas Young, M D. F. R. S.—*Phil. Journ.* No. 79.

In this short paper Dr. Young states, that having had occasion to employ the rules derived from the hydraulic experiments of Dubuat, he has reduced them into a more correct form than those delivered in the second volume of his lectures on natural philosophy, page 225, and therefore communicates the formula.

He says that Dubuat's rule in English inches is $\frac{l + 45\,d}{h} = b$, and $v = 153\,(\sqrt{d} - .2).\left(\frac{1}{\sqrt{b} - h\,.\,l\,\sqrt{(b + 1\,.\,6)}} - .001\right)$ l denoting the length of a pipe, d its diameter, h the height of the reservoir, and v the velocity in a second. He transforms the formula to the following one, namely, $v = 153\,(\sqrt{d} - .2) \cdot \left(\frac{10\sqrt{b} + 75\,c + 8}{10\,b} - .0012\right) c$ being $= \frac{b}{10} - 1$. This transformation he derives from the position that the hyperbolic logarithm of x is equal to $n\,x^{\frac{1}{n}} - n$, when n is infinite and that it is nearly so when n is any large number.

Observations.—This transformation of Mr. Dubuat's formula is ingenious; and it must be allowed that the expression, into which it is transformed, is much simpler and convenient than before: at the same time, the position, from which it is derived, is only an approximation to the truth when n is not infinite.

Proposals for a new System of building Houses, Streets, &c. *By Mr.* G. Field.—*Phil. Mag.* No. 114.

In consequence of having seen in the second volume of the Retrospect an abstract of a paper in the Farmer's Magazine on the figure in which trees should be disposed in plantations, Mr. F *resumed* an essay that had laid by him for several years.

As the circle circumscribes a much greater area than the square (whose sides are collectively equal to the circumference) so, at the same time, its extremeties lie nearer together; of course, a considerable saving of materials would be made in building circular buildings instead of square ones.

To this may be added, that of all forms of buildings the circular is the most simple, most durable, and the strongest. It is also superior in beauty and sublimity, as presenting *one endless* front, and being susceptible of every variety of architectural decoration. The view from circular edifices is much more extensive than from square buildings; and they may be formed upon the principle of the cask, the materials being formed into girders or hoops resting upon each other. And in like manner *staves* may be framed of wood or other materials, to be connected by hoops or bolts, and the openings may be pannelled, plastered, or bricked up.

The natural form of a roof for a circular building is the dome, which may also be constructed on the principle of the cask, or of rings diminishing upwards, and resting upon each other, so as to require no other support; while, at the same time, it is perhaps the only roof that is beautiful, others being purposely hidden.

The floors would require less timber, or may be more strongly and flatly vaulted with masonry than in other forms of building. The stairs may be disposed in the centre of the building, and lighted from the top by a lantern.

The arrangement of the buildings in a circle of circular buildings is stronger than any other; and the interior of the circle would form a magnificent amphitheatre. As each house would touch the others only in a point, they would require no party-walls; and in case of fire, engines could reach a much greater surface of each house. Each house would be better lighted and ventilated than in any other arrangement, and would have a more extensive view and front. Each house also being within sight and communication with every other of the circle, the arrangement would be the least solitary.

A building or buildings around a circular court in the centre might form the offices to each house; and one common receptacle, at the furthest possible distance from each house, might receive and carry off the filth, by a sewer running under the passage which leads into this court.

These circles of circular houses are arrangeable in circles of a higher order to infinity, by which there would be the freest circulation of air and the quickest possible intercourse with the other parts.

Public buildings might occupy a grand circle in the centre of the city.

It may be observed that the circle is the form indicated by nature, and instinctively followed by inferior animals in the construction of their habitations, and in the huts of infant societies, as those of the Caffres.

Observations.—The plan here proposed could only be adopted with effect in those few cities which, like Babylon, Alexandria, and St. Petersburgh, have been sketched out at once. As these

instances occur so very seldom, the idea cannot be regarded as of any great value, and is excessively fanciful. A great inconveniency would also arise from the buildings not admitting of any subsequent addition, unless it were of round towers in the style of some of the houses in Vanburgh-fields near Greenwich and even these would spoil the uniformity of the circles, so that it could only be used by those nations who live in the most simple style, and use of course the most simple huts disposed in small villages.

Description of a circular Mother-of-pearl Micrometer. By DAVID BREWSTER, A. M..—*Phil. Mag.* No. 113.

MR. CAVALLO gave in the Philosophical Transactions for 1791, an account of an ingenious micrometer consisting of a slip of mother-of-pearl minutely subdivided, and stretched across the diaphragm that is placed in the anterior focus of the fourth eye-glass of an achromatic telescope. But this micrometer cannot be used in reflecting telescopes, nor in any achromatic telescopes where the adjustment of the eye-piece is effected by rack-work, unless the structure of these instruments is altered for the purpose. And again as the micrometer passes through the centre of the field, the view is rendered unpleasant by the field being divided in two unequal segments; to which may be added that the different divisions of the micrometer are at unequal distances from the eye glass, they neither appear equally distinct, nor subtend equal angles at the eye.

To obviate these inconveniences, a mother-of-pearl ring was used, having its interior circumference divided into 360 equal parts. This ring was fixed at the end of a brass tube made to move between the third eye glass and the diaphragm, so that the divided circumference may be placed exactly in the focus of the glass next the eye. The angle subtended by the diameter of the micrometer may be determined by measuring a base, or by the passage of an equatorial star; from whence the angles subtended by any number of divisions or degrees may be calculated.

The manner of calculating the values of these angles, and a table of the constant part of the formula is given by Mr. B.

By this method of measuring, there is no occasion for turning the micrometer round its axis, because the divided circumference lies in every possible direction. And as the angle to be measured increases, the accuracy of the scale also increases; for when the arch is only 1 or 2 degrees, a variation of one degree produces a variation of about 16 seconds in the angle; but when the arch is between 170 and 180 degrees, the variation of a degree does not change much more than a second in the angle.

In Mr. B's own micrometer, the diameter of the field of view is exactly half an inch; the brass tube in which it is fixed is one

inch in diameter, and half an inch long, and the degrees of the divided circumference 1-230th of an inch each.

Observations.—We consider this micrometer as a very useful improvement in practical astronomy.

Description of an Engine for affording Mechanical Power from Air expanded by Heat. By Sir GEORGE CAYLEY, Bart.—*Phil. Journ.* No. 79.

THIS engine consists of two cylinders placed one above the other, each having a piston, connected with that of the other, by the same piston rod, passing through stuffing boxes in their contiguous end.

These cylinders are connected by pipes with a close vessel containing the fuel and the fire place; a vessel containing fuel for the supply of the fire is placed above the fire place, and furnished at top with an air-tight stopper, which is carefully screwed on when the vessel is filled with coals or coak.

The lower cylinder serves the purpose of a double bellows, forcing air to the fire place, both at the ascent and descent of its piston. In the upper cylinder, the heated air operates as the moving principle of the engine, and acting alternately by its pressure above and below the piston, causes it to ascend and descend according as the valves are opened, which permit the communication with the fire vessel, and with the external air, with both which the two cylinders are connected by pipes at their different extremities.

Nothing more is mentioned of the method of moving the valves or cocks, but that it is to be done by a "plug-frame" but the means of doing this is sufficiently obvious.

At the end of the description Sir George mentions "that if the "expansion of the air in keeping up the fire, is not found suffi- "ciently sensible, still the form of the Engine is such, as to ad- "mit of either inflammable gas, oil of tar, or other inflammable "matters being injected each stroke upon the fire, so that all the "heat, generated by the united combustion, may operate with- "out waste, perhaps even a slight sprinkling of water either upon "or round the sides of the fire, might answer the purpose, a tube "connected with a spring pump is all that would be necessary to "produce these effects."

An engine of this kind was made at Newcastle, but did not succeed; it was however constructed so badly as not to be air tight, and therefore could not exhibit a fair experiment of the principle.

Observations.—Sir George Cayley's engine is so environed by

patents, that if it could be brought to act, it is very doubtful if its use would not involve the proprietor in a lawsuit with some patentee.

A patent was taken out by Mr. Medhurst in Feb. 1799, for working an engine by condensed air ; (the specification of which may be seen in the Repertory of Arts, Vol. 4. Second Series) ; and on this patent Sir G. Cayley's engine will in some degree infringe, as the air in Sir George's receives a condensation in the lower cylinder, but it is probable this objection would not hold, as the heat is the principle of action and not the condensation.

The use of the inflammable air, mentioned in the quotation from Sir George's paper, which would be very likely to cause explosion, appears something like an imitation of Barber's patent for a method of using inflammable air for causing motion—See Repertory of Arts, Vol. 8, First Series.

The union of the air and water, also mentioned in the same quotation, would infringe on the patent granted in 1801 to Mr. James Glazebrook, of Coalbrook Dale, for working machinery by the various gases or airs, in conjunction with water.

But there are more powerful reasons to deter from the use of this engine than the dread of lawsuits, even if it could be brought to act with any power, which is extremely doubtful ; the expense of its construction and working, would be nearly equal or more than that of a steam engine, while its power would be so very inferior, that no rational person would use the former, when he could procure the latter, unless on a very small scale as an object of curiosity.

REVIEW OF SPECIFICATIONS OF PATENTS.

PUBLISHED IN THE REPERTORY OF ARTS.

Mr. Alexander John Forsyth's *Patent for a Method of discharging, or giving Fire to Artillery, and all other Fire-Arms, Mines, Chambers, Cavities, and Places in which Gun-Powder or other combustible Matter is or may be put for the Purpose of Explosion.—Repertory of Arts,* No. 66, New Series.

Mr. Forsyth closes the touch-hole or vent by means of a plug, or other fit piece of metal or suitable material, so as to exclude the open air, and to prevent any sensible escape of the blast or explosive gas, or vapour outwards, or from the priming or charge, and as much as possible to force the priming to gain the direction of the charge, and to set fire to the same. As a priming instead of gun-powder he makes use of some of those chemical compounds which are so easily inflammable as to be capable of taking fire

and exploding without any actual fire being applied to them, and merely by a blow, or by any sudden or strong pressure or friction given or applied to them. He uses, for instance, some one of the compounds of combustible matter as sulphur, or sulphur and charcoal, with an oxymuriatic salt; or he makes use of such of the fulminating metallic compounds, as may be used with safety, as fulminating mercury; or of common gunpowder mixed in due quantity with any of the before-mentioned substances, or of suitable mixtures of any of the before-mentioned compounds.

Observations.—Mr. Forsyth's method of discharging fire arms is by no means so simple as the present, even when considered in a mechanical view. But when we advert to the excessive ease with which the oxymuriate of potash, and fulminating mercury explode, we shall find sufficient reason to expect so many repetitions of the dreadful accidents which have already occurred in making use of the compositions, that we can by no means recommend the adoption of the methods he proposes. These accidents have arisen from the oxymuriate of potash, not bearing a sudden shake without exploding; and such jolts could by no means be avoided in actual practice.

Mr. James Bradly's *Patent for a new Kind of Iron Bar to be used in Fire-Places. Dated July*, 1807.—*Repertory of Arts*, No. 67, New Series.

This method of making bars for fire-places, consists only in making them hollow from one end to the other; and, in order to provide against any accidental stopping of their ends, a hole or holes is made on each side, and at opposite ends, or at the lower edge of each bar, so that the air may be freely admitted into them through these openings.

The advantages of this construction, as stated by the patentee, are, that the bars being kept cooler, they will endure a greater degree of heat without injury, will last longer, and will, in a great degree, prevent the coals from burning to clinkers.

Observations.—The principal advantage that we perceive in these bars is, that the under part of the bar being kept cooler, it will support the upper surface, and prevent the bending of the bar. Mr. B. intends his bars to be inserted into the walls of the furnace, but in this case, their expansion injures the furnace, and the fire-place is in continual want of repairs. In small furnaces, this is avoided by using loose bars, resting upon two supporting bars, and this method has the further advantage, that the draught of air may be regulated by inserting an extra bar, when only a slight heat is required. It would be an improvement of Mr. Bradley's bars, to adopt a similar method, and instead of fixing them in the walls

of the fire-place, to place them upon two or more supporters, not fixed in the walls, but resting upon ledges, and to retain the fire-bars at the proper distance, by indentures in the upper surface of the supporters, which might also be made hollow.

Mr. JOHN NORTON'S *Patent for a new invented Pump. Dated July*, 1807.—*Repertory of Arts*, No. 67, New Series.

MR. Norton's pump consists of a working barrel, with a double set of pipes attached to it, which communicate with its top and bottom, both of which are water-tight; the piston is moved up and down in the middle of the barrel by a crank, that is likewise enclosed in the barrel, and whose gudgeons pass outwards through holes at each side, over which plates are screwed, which have perforations made in them, but just sufficient to let the gudgeons pass, without permitting any water to ooze out. The working barrel may be either placed vertically or horizontally; but when the latter, the pipes which convey the water (as represented in the figures, which accompany the specification) communicate in two places at either end of the barrel, making four communications in all, instead of two only, one at the top and the other at the bottom, with which the vertical barrel is represented.

Observations.—Mr. Norton's plan contains two old inventions united, that of a pump with one piston, which forces water forward, both in its descent and rise; and that of working a piston up and down, by a crank.

The only advantage of the use of a crank consists in affording a simple method of converting a circular motion into an alternately reversed motion; for in itself it is very defective, exhibiting great inequalities of velocities and power in each semi-revolution; for this reason it is a very false application of it to use it where the motion required can at once be given by hand without its aid, as it very well may be in Mr. Norton's pump by a common pump handle, or any similar contrivance.

The method of applying the crank to work the piston, is very unnecessarily complicated, and liable to be put out of order, and when so, difficult to be righted, and without stuffing boxes for the gudgeon could never be kept water tight. The crank and the joints of the piston rod being concealed in the barrel may give a neat appearance, it must be owned, but this only tends to deceive the unskilful, by performing the motion required, without exhibiting the means of doing it, while in reality it has the defects mentioned, and is therefore much inferior to the common method of managing a solid piston which is required to act both downwards and upwards, and which method consists in passing the piston rod through a stuffing box; and if any crank work is to be applied,

(which can be only needful when the piston is to be worked by a water mill, or wind-mill) to have it all outside in open view.

For these reasons we can see nothing to approve in Mr. Norton's pump, and think it will never come into general use.

Mr. JOHN PALMER'S *Patent for a new Method of constructing and erecting Bridges. Dated June,* 1807.—*Repertory of Arts.* No. 65, New Series.

IN these bridges, a bar of cast-iron is to be enclosed in the abutment of the bridge, and the piers or supporters are to be formed of cast-iron, on bases of the same metal, resting upon a firm bottom. The number of supporters to vary according to the breadth of the stream. Chains are to be passed from the abutments along the supporters; these chains are to be bound together, and prevented from swagging by iron rods being passed through them at proper distances; on which planks fastened together with hinges, or rings, are to be placed. The side-fences of these bridges are also formed of chains, to which may be added a wire fence, if thought necessary.

Observations.—The introduction of piers, or supporters into these kind of bridges cannot be regarded as an improvement. The hanging bridges without piers of the natives of South America, which are also used in some parts of Africa are peculiarly adapted to mountainous countries, or the necessities, and resources of uncivilised countries. But the repeated curvilinear depressions which would be introduced by the use of piers, in the middle of the chain, would be so disagreeable that this construction never could be adopted but where local exigences necessitated persons to employ this mode.

Mr. JOSEPH BOWYER'S *Patent for manufacturing Carpets and Carpet Rugs, Dated May* 1807.—*Rep. Arts,* No. 65, N.S.

THE object of this patent is to manufacture carpeting with a firm and even body, so that it may not be reved or pulled out by brushing, or the scratching of animals. The pattern is raised above the ground work, and may be made both comber and point. The colours are read in, and put into the loom as at present, except the ground, which is not to be read in, but to be composed of a chain or warp of double the number of threads now usually used. This chain or warp is to be turned upon a roll, and worked under the frames with bobbin and ball, or bobbin and anchor, or any other means. This ground is not worked in

the eyes of the great harness, but will require two additional shafts to the little harness, which may consist of 5 or more shafts.

The ground to be made of worsted, woollen, silk, cotton, &c. and the under or binding part of flax or hemp.

If the little harness consists of 5 shafts, 2 are to work the floating ground; 2 the linen or binding part, and one to work the colours or figures, being that which in Brussels carpeting is called the poleshaft. If the weaver uses 6 treadles, he can raise the floating part of the ground himself, or else he must employ a person or machine to raise it for him, in which case 4 treadles will be sufficient.

If he raises the ground himself, the draw-boy draws a lash and turns up the sword, at the same time that the weaver treads the outside treadle on one side, which throws in a shoot. He then takes his foot off the outside treadle, and puts in a wire rod to raise a pile either for cut or drawn. The sword is then taken out, and he treads the second treadle, and throws a shoot of the binding linen. He then treads the third treadle, which treads down the binding shaft only and raises the rest He throws a shoot as on the last treadle, which is the binder for that wire. The boy draws a fresh lash, and the weaver proceeds as before.

In respect to carpet-rugs, they are manufactured in the same manner, a strong warp of hemp, &c. being used to give them substance, and also a larger size wire rod, or any like kind of instrument to raise a higher pile.

Mr. Samuel Williamson's *Patent for an improvement in Weaving by Looms. Dated December* 1807.—*Repertory of Arts,* No. 66. New Series.

This invention consists in additional machinery for impelling the shuttles from the shuttle box, in the middle of a lathe of a loom constructed for weaving two pieces of cloth at the same time, to the shuttle boxes at each end of the lathe.

A rod of iron, or other metal, is fixed at each end of the lathe hood, at such distance as to permit a runner to run freely on each rod. A picking-rod placed between the two rods contained in the lathe carries two pickers, which are connected crossways with the runners on the lathe hood, by wooden rods, or otherwise. Strings are suspended on the axis on which the lathe moves, that connect the runners with the pickers placed on outside of each reed, and also with a handle, which the weaver holds in his hands, and with which he is enabled to pick both the shuttles at the same time.

Mr. Henry Maudslay's *Patent for Improvements in the Construction of Steam Engines, Dated June* 1807.—*Repertory, of Arts, &c.* No. 65, New Series.

Mr. Maudslay's view in the Engine for which his patent is obtained, was "to reduce the number of parts of the common "steam engine, and to so arrange and connect them, as to render "the whole more compact and fit for carriage, every part thereof "being fixed to, and supported by a strong frame of cast iron, "perfectly detached from the walls of the building in which it "stands, and being thereby less expensive in fixing, and not liable "to get out of order by the sinking of foundations."

The arrangement of the parts of this engine is as follows:—The main cylinder is placed over the crank of the fly, which is a square frame of cast iron, consisting of four uprights and a platform; on the top of the piston rod is fixed a cross piece, from the ends of which two rods descend to an axis, which is confined to an ascending and descending motion, by friction wheels moving between perpendicular grooves. From this axis two other rods ascend to two cranks on the arbor of the fly wheel, between which is placed a third shorter crank, that gives motion to a short balance beam, which works the air pump at its different ends, by means of a fork that descends from its centre, and receives the crank between its legs.

The air pump is contained in the cold water cistern, as usual, and round the cold water pump is another similar cistern that communicates with the first by a pipe. Above the air pump a hot water cistern is placed, containing the hot water pump, which is worked by the same beam as the other pump, by a rod attached nearer to its centre than those of the others. Instead of valves, a cock of "*four ways*" is used, that is turned by an arm which ascends from the centre of the pump beam mentioned, and which alternately opens and shuts the communications between the upper and lower portions of the cylinder, with the boiler and condenser.

Observations.—There cannot be said to be any thing new in this engine as to the essential objects of its construction, as stated by the patentee; the plan of fixing the whole engine to a cast iron frame detached from the building, has been practised for several years; and some engines with frames of simpler and more firm construction, than that proposed by the patentee, may be seen at the Bristol wet-docks, which were erected long before the date of his patent.

The only simplification of parts in this engine, is that caused by

the substitution of the "*cock with four ways,*" for valves and their working gear. Cocks were used originally in Savary's engine, and others of early date; but were found so difficult to keep in order, that they have long since been entirely superseded by valves. It seems, therefore, rather strange, that the patentee should propose the use of cocks again for this purpose, especially as he has not suggested any means for remedying the defects for which their use was originally rejected.

The principal defect in this engine is, that there is no guide or support in it to preserve the top of the piston rod in a perpendicular position as it ascends or descends.

The simplest method to remedy this evil, would be, probably, to make the piston rod proceed from the bottom of the cylinder instead of the top.

Mr. Robert John Stanley's *Patent for Tanning Leather without Bark, or Mineral Astringent, except in the Tanning of Backs and Bends. Dated April* 1807. *Repertory of Arts,* No. 67, New Series.

This method of tanning differs very little from the usual mode. The hides and skins are prepared with bran and water for two days, previous to their being put into the ouze. The ouze for skins is composed of half a pound of Aleppo galls, five pounds of tormentil, or septfoil root, and an ounce and a half of Bengal catechu, boiled in seventeen gallons of water. When the ouze is become cold in the vats, the skins are to be put in, and handled frequently the three first days, then left for two or three days, afterwards handled several times in one day, and then left undisturbed for about twenty-five days; after which they are to be taken out, and dried as usual

The ouze for hides is the same as for skins, but they are to be frequently handled for the first six or seven days; then left quiet for a fortnight, afterwards handled frequently for two or three days more, and then only at intervals, as the tanner may judge necessary, for the space of ten or twelve weeks, and then dried in the usual manner.

For tanning thick hides for backs and bends, it will be necessary to add as much oak bark as of tormentil or septfoil root.

Observations.—In page 488, we gave some observations upon tanning, which will apply to the present patent. It is probable that the addition of tormentil or septfoil root will in some measure counteract the bad effect of the ouze being too strong.

We may also add to our former remarks on the leather trade in general, that it would be advantageous if the separation of the businesses of the tanner and currier were abolished, since the responsibi-

lity of these artists is diminished by this separation, as each may, and frequently does lay the blame of the bad preparation of the leather upon the other; whereas if the same tradesmen prepared the hides, and furnished it in a working state to the cordwainer, or other worker, it would be easy to attach the blame on the right person, if any leather wares did not turn out good.

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